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AN INDEPENDENT ASSESSMENT OF TWO FIRE SUPPORT SYSTEMS, AFATDS AND MIFASS

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January 1987

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and

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(U) This annotated briefing documents the results of an independent assessment of two fire support systems, the Army's Advanced Field Artillery Tactical Data System (AFATDS) and the Marine Integrated Fire and Air Support System (MIFASS). The analyses considered three alternatives: (1) Marines terminate MIFASS and join AFATDS, (2) Army terminates AFATDS and joins MIFASS, and (3) continue both efforts as presently programmed. The recommendations include continuing AFATDS, completing the MIFASS operational test, putting MIFASS developmental equipment in an operational Marine Amphibious Brigade, testing the adaptability of AFATDS to meet the Marine Corps' needs, and providing a detailed development and fielding plan for the Marine Corps' system based on the results of the Adaptability Evaluation Program and the MIFASS operational test.

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INSTITUTE FOR DEFENSE ANALYSES

PREFACE

(U) This report is submitted in accordance with contract MDA903 84 C 0031, Task T-J1-443. The objective of this task was to conduct an independent assessment of the Army's Advanced Field Artillery Tactical Data System (AFATDS) and the Marine Integrated Fire and Air Support System (MIFASS).

(U) This task was accomplished by the System Evaluation Division of the Institute for Defense Analyses (IDA). The study team consisted of Dr. L. Scheiber (Project Leader), Dr. R. Morton, Mr. H. Shoemaker, and Dr. R. Walker. The study team would like to thank the many people who contributed to and reviewed the results of the study. At the risk of being incomplete, the study team would especially like to thank Dr. R. Atwell, Mr. H. Cheilek, BG G. Corliss (USMC, Ret), Dr. L. Golliday, BG J. Gerrity (USA, Ret), Dr. P. Gould, Dr. R. Ivanetich, Ms. K. James, Dr. P. Liou, Mr. T. Maggelet, Dr. F. Miercort, and Dr. D. Randall, for their critical reviews, helpful suggestions, and timely assistance.

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2

INTRODUCTION

(U) The Army and the Marine Corps are both developing automated fire support systems for use on the battlefield starting in the early 1990s. The GAO and Congress have for a considerable period of time been asking questions as to why both of these systems need to be developed.

(U) On 15 July 1986 the Under Secretary of Defense for Research and Engineering, in a letter to the Services, said " . . . I believe a review of both programs should be conducted at this time to examine in depth the following alternatives:

(1) Marines terminate MIFASS and join AFATDS

(2) Army terminates AFATDS and joins MIFASS

(3) Continue both efforts as presently programmed.

The Army and the Marine Corps are requested to provide a joint briefing on this matter . . . In accordance with the wishes of the Secretary of Defense, IDA has been asked to conduct an independent assessment of the Service positions."

(U) The IDA study team reviewed the programs, visited organizations involved, operated the fire support equipment, collected extensive data, and also received the Service briefings. The information used for the study was placed in the form of tables associated with the issues developed for the study and is contained in the Appendixes to this report. The material in these Appendixes was reviewed with the Services in mid-November 1986 to ensure that the conclusions and recommendations drawn from it would have a firm foundation. Although updates have been incorporated where new data could be confirmed, for the most part the data included should be considered correct as of the mid-November Service reviews.

(U) The front part of this report contains the results of the IDA assessment in the form of an annotated briefing.

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4

CONTENTS

(U)   The Institute for Defense Analyses (IDA) was tasked by the Office of the Secretary of Defense (OSD) to provide an independent assessment of the potential to consolidate the U.S. Marine Corps' Marine Integrated Fire and Air Support System (MIFASS) and the U.S. Army's Advanced Field Artillery Tactical Data System (AFATDS).   The study sponsors are: Office of the Assistant Secretary of Defense (OASD) for Command, Control, Communications, and Intelligence (C3I) and the Office of the Under Secretary of Defense for Acquisition (OUSDA), Tactical Warfare Programs (TWP)/Land Warfare (LW). The task order and additional tasking guidance are contained in Appendix F.

(U)   On 15 July 1986, the Army and Marine Corps were directed by the Under Secretary of Defense for Research and Engineering (USDRE) to examine in depth three alternatives and to provide decision briefings on the results of the examinations. The three alternatives were:

1.   Army terminates AFATDS and both Services field MIFASS.

2.   Marine Corps terminates MIFASS and both Services field AFATDS.

3.   Continue both efforts as presently programmed, i.e., Army fields AFATDS and Marine Corps fields MIFASS.

(U)   The IDA study was directed to provide comments on the Service decision briefings that were eventually presented to the Assistant Secretary of Defense (ASD) for C3I and the Deputy Under Secretary of Defense (DUSD) for TWP on 7 October 1986. Further, the study was directed to examine Service requirements and program data to the extent necessary to define the consolidation tradeoffs.

STUDY OBJECTIVE AND SCOPE

- **OBJECTIVE**

  To Provide an Independent Assessment of the Potential To Consolidate the MIFASS and AFATDS Programs

- **SCOPE**

  In Addition to the Service Decision Briefings, the Study Should Examine Service Requirements and Program Data to the Extent Necessary To Define the Consolidation Trade Offs. The Following Options Are To Be Considered:

  1. Both Services Field MIFASS

  2. Both Services Field AFATDS

  3. Army Fields AFATDS

     and

     Marine Corps Fields MIFASS

7

LS-16-30

(U)   This section provides information on why the study was done and gives a brief background on each of the two fire support systems (AFATDS and MIFASS) that are the subjects of the study. Also, a brief discussion of the battlefield fire support organization of both Services is included herein. The section concludes with a brief description of some ongoing and completed command and control (C2) study efforts at IDA.

8

BACKGROUND

- WHY THE STUDY?

- WHAT IS AFATDS?

- WHAT IS MIFASS?

- FIRE SUPPORT ORGANIZATIONS AND ASSOCIATED TASKS

- SOME IDA ONGOING AND COMPLETED C2 STUDY EFFORTS

(U) This chart summarizes recent events that led to this study. Generally, there is heightened interest by the Services, OSD, the General Accounting Office (GAO), and the Congress in clarifying the need to have both battlefield fire support systems, AFATDS and MIFASS. Detailed schedule and tasking information are contained in Appendixes F and G.

(U) In the past year funding constraints have forced the U.S. Marine Corps (USMC) to defer initial production funding for MIFASS until FY 90, although alternatives for an FY 89 start are still being actively explored. The result of this decision is an alignment of the development and fielding schedules for AFATDS and MIFASS (Appendix F).

(U) For the past 3 years the GAO and Congress have taken specific interest in the development of automated battlefield command and control systems. Recent GAO reports include reivews of fire support command and control systems in 1983 and 1986.[1]

(U) In the Congressional review of the FY 87 Department of Defense (DoD) budget request, research and development (R&D) funds for additional software and hardware development for AFATDS and MIFASS were zeroed. Only funds for AFATDS program management and MIFASS operational testing have been released to date by Congress for FY 87. Congress has required that DoD provide a report on its plans to continue development of fire support command and control systems to the U.S. House Armed Services Committee (HASC) and the U.S. Senate Armed Services Committee (SASC) by mid-December 1986.

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[1](U) GAO, *Development of Fire Support Command and Control Systems by the Army and the Marine Corps*, GAO/NSIAD-84-15, 19 October 1983, UNCLASSIFIED; *Status of the Marine Corps Integrated Fire and Air Support System*, GAO/NSIAD-86-111FS, April 1986, UNCLASSIFIED; *Army's Efforts to Improve the Field Artillery Tactical Data System*, GAO/NSIAD-86-116BR, May 1986, UNCLASSIFIED; *Army's Plans to Improve Its Fire Support Capabilities*, GAO/NSIAD-86-116BR, September 1986, UNCLASSIFIED; and *Status of the Fire Support Systems' Development*, GAO/NSIAD-86-212FS, September 1986, UNCLASSIFIED.

WHY THE STUDY?

- ALIGNMENT OF DEVELOPMENT AND FIELDING SCHEDULES

- CONGRESSIONAL REQUESTS

- ZEROING OF FY 87 BUDGETS FOR ADDITIONAL DEVELOPMENT

- REQUIREMENT FOR INDEPENDENT ASSESSMENT

- DoD REPORT TO HASC AND SASC BY MID-DEC 1986

11

UNCLASSIFIED

(U) This chart summarizes the key elements of the development approach, status, and future milestones for AFATDS. AFATDS is one of five battlefield automated command and control systems that, together with the Force Level Control System, make up the Army Command and Control System (ACCS). AFATDS is intended to be fielded to the entire Army--active, reserve, and national guard--at echelons from corps to battery to support its fire support tasks.

(U) AFATDS is the first system in the Army's new approach of developing the system concept and software first and then selecting appropriate non-developmental-item (NDI) hardware to support them. More than half of the 1,350,000 lines of Ada code envisioned for AFATDS will be completed before the ACCS common hardware/software request for proposal (RFP) will be released.

(U) AFATDS is currently in concept evaluation, which will culminate in a Concept Evaluation Program (CEP). Software for CEP consists of 750,000 lines of code (LOC). The hardware is a brassboard system with some components designed for future militarization. CEP testing is scheduled to end 31 July 1987, and the results are planned to be available later in 4Q FY 87. Appendix F contains two detailed AFATDS schedule charts.

(U) The production system will use NDI hardware procured in part as ACCS common hardware and part as AFATDS-unique equipment. The ACCS RFP is planned to be released 2Q FY 87 for an award in 1Q FY 88. AFATDS-unique equipment will be specified based on the results of the CEP testing and review of the configurations and components available through ACCS.

(U) Two versions of software will be developed in parallel during FY 88 and FY 89. Version 1 will contain some software improvements over CEP and is planned to achieve Initial Operational Capability (IOC) in 1Q FY 90 for fielding to the light divisions, III Corps, and a training base. Version 2 will contain additional software capabilities, including nuclear/chemical and corps-level functions; it will reach IOC in FY 91 for fielding to the remaining corps and divisions.

WHAT IS AFATDS?

PURPOSE - AFATDS IS THE ARMY'S ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM. IT IS A PROGRAM TO DEVELOP AND FIELD AN AUTOMATED SYSTEM TO THE ENTIRE ARMY TO SUPPORT ITS FIRE SUPPORT TASKS AND THE FORCE LEVEL CONTROL SYSTEM OF ACCS. SYSTEM DESIGN AND SOFTWARE DEVELOPMENT STARTED IN 1984.

APPROACH - AFATDS IS THE FIRST SYSTEM IN THE ARMY'S NEW APPROACH OF DEVELOPING THE SYSTEM CONCEPT AND SOFTWARE FIRST AND THEN SELECTING APPROPRIATE NDI HARDWARE TO SUPPORT THEM.

STATUS - SYSTEM IS CURRENTLY IN CONCEPT EVALUATION. THE CONTRACTOR IS DEVELOPING HARDWARE (BRASSBOARD) AND SOFTWARE (APPROXIMATELY 750,000 LINES OF ADA CODE) FOR A CONCEPT EVALUATION PROGRAM (CEP). CEP RESULTS EXPECTED 4Q FY 87.

MILESTONE III - 4Q FY 89.

PRODUCTION CONCEPT - USE NDI HARDWARE WHOSE AVAILABILITY IS CONSISTENT WITH FIELDING SCHEDULE. NDI PROCURED VIA ARMY'S COMMAND AND CONTROL SYSTEM (ACCS) PROGRAM. SOME SOFTWARE IMPROVEMENTS PLANNED. OTHERS MAY BE IDENTIFIED AS PART OF CEP.

IOC - 1Q FY 90 FOR LIGHT DIVISIONS AND III CORPS. VERSION 2 SOFTWARE IOC IN FY 91.

(U)   This chart shows some of the AFATDS equipment developed for CEP. These components are representative of the hardware and the configurations planned for the AFATDS IOC system. An example configuration diagram is provided at the end of Appendix F.

(U)   The Fire Support Terminal (FST) provides a Motorola 68020 32-bit microprocessor, up to 16-megabytes (MB) of random access memory (RAM), four modems, a power supply, and a local area network (LAN) interface. (The LAN is not shown on the chart.) A larger workstation, the Fire Support Computer Terminal (FSCT), provides additional memory (up to 56 MB of RAM) and microprocessors (up to 3). Both workstations have dedicated keyboards and small-screen displays with touch control for data entry. Most planned AFATDS configurations have one FSCT and two or more FSTs. FSTs are designed to operate in a standalone mode or with other workstations using the LAN.

(U)   Another key AFATDS component is the medium-screen display (MSD). The MSD has touch control and provides graphics using a plasma panel. A paper map can be inserted behind the panel so that the graphics can be displayed as a map overlay. The LAN and an FST or FSCT would be required to operate the MSD.

(U)   The chart also shows a Program Load Unit (PLU); it is a 10-MB hard disk with removable media for CEP. In addition, the chart shows an Electronic Printer (EP) and a Power Converter Group (PCG). The EP in CEP is a commercial off-the-shelf unit without added ruggedization. The components other than the EP and PLU are representative of highly ruggedized NDI equipment.

SOME AFATDS CEP EQUIPMENT

MEDIUM-SCREEN
DISPLAY

ELECTRONIC
PRINTER

PROGRAM
LOAD UNIT

POWER
CONVERTER
GROUP

FIRE SUPPORT
TERMINAL

FIRE SUPPORT
COMPUTER
TERMINAL

15

(U) This chart summarizes the key elements of the development approach, status, and future milestones for MIFASS. MIFASS is one of seven automated command and control systems that make up the Marine Tactical Command and Control System (MTACCS). MIFASS provides coordinated fire support for air and ground assets, along with naval gunfire and forward area air defense (FAAD) assets, and integrates the command and control of all of these fire support means into maneuver operations. MIFASS is intended to be fielded to the entire Marine Corps--active and reserve--at all echelons from the force headquarters to the battalion fire direction centers (FDCs) and fire support coordination centers (FSCCs).

(U) MIFASS development started in 1979; the development approach is the traditional one for tactical data systems, in which custom hardware and software are developed at the same time. The hardware is designed to meet full military specifications (MILSPECs), including environmental conditions.

(U) MIFASS is currently in operational testing (OT II). Results from OT II are expected in 3Q FY 87, based on the current Marine Corps schedule. The Milestone III production decision is planned for 4Q FY 87. A number of preproduction hardware and software upgrades are planned to be completed during FY 88 and FY 89. Production is planned to start in 1Q FY 90. An initial operational capability would be reached in 1Q FY 93. Complete fielding is planned for FY 93 to FY 97. A detailed schedule for MIFASS is provided in Appendix F.

16

WHAT IS MIFASS?

PURPOSE - MIFASS IS THE MARINE CORPS' MARINE INTEGRATED FIRE AND AIR SUPPORT SYSTEM. STARTED IN 1979, IT IS A PROGRAM DE-SIGNED TO DEVELOP AND FIELD AN AUTOMATED SYSTEM TO THE ENTIRE MARINE CORPS TO SUPPORT ITS FIRE SUPPORT TASKS.

APPROACH - MIFASS REPRESENTS THE TRADITIONAL TACTICAL DATA SYSTEM DEVELOPMENT APPROACH OF DEVELOPING THE HARDWARE AND SOFTWARE AT THE SAME TIME.

STATUS - THE SYSTEM IS CURRENTLY IN OT II. THE HARDWARE IS MILSPEC. QT II RESULTS ARE EXPECTED 3Q FY 87 IN THE CURRENT SCHEDULE.

MILESTONE III - 4Q FY 87.

PRODUCTION CONCEPT - SOME PREPRODUCTION HARDWARE AND SOFTWARE CHANGES HAVE BEEN IDENTIFIED. OTHERS MAY BE IDENTIFIED IN OT II. PRODUCTION EXPECTED TO START 1Q FY 90.

IOC - 1Q FY 93.

17

LS-16-24

(U)   This chart identifies the components of MIFASS, together with two additional equipment items developed by the Marine Corps. The central and largest component is the Dynamic Situation Display (DSD). The DSD has a larger screen but is comparable in planned capability to the AFATDS medium-screen display. In particular, the DSD has touch control and a plasma screen designed to provide graphic overlays to paper maps. In contrast to the AFATDS medium-screen display, the DSD has a keyboard.

(U)   Starting from the lower left and going clockwise in the chart, the Digital Communications Equipment (DCE) provides all digital interfaces to external communications media. The Star Coupler (SC), together with appropriate 0.5-in cables, is a wire data bus connecting all digital data components. The Mass Storage Device (MSD) is a magnetic tape unit that provides permanent storage of software and data.[1] The Power Module (PM) provides power conversion and conditioning. It also provides uninterruptable power by switchover to backup power via the Battery Box (BB) when required.

(U)   Key digital processing components are the Mass Memory (MM) and Microcomputer (MC). The MM, after a preproduction upgrade, will have 2 megawords or 4 MB of RAM. The MC is a standard Navy AN/AYK-14 16-bit microcomputer repackaged for MIFASS. Other MIFASS devices are the Communication Control Panel (CCP) for voice communications and the Type 1 (slow) and Type 2 (fast) electronic printers.

(U)   Two of the devices shown on the chart are handheld units that were developed for use with MIFASS. They are the Digital Communications Terminal (DCT) and the Fire Direction/Survey Calculator (FD/SC). The DCT was developed under another program and will be used as a remote input/output device for forward observers, battery command posts, field commanders, and other battlefield elements. The FD/SC was developed under MIFASS, but it is not currently planned for fielding.

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[1](U) Note that "MSD" is an acronym also used in AFATDS for the medium-screen display.

MIFASS SUBSYSTEMS

MICROCOMPUTER (MC)

TYPE 2 PRINTER (T2P)

COMMUNICATIONS
CONTROL PANEL (CCP)

TYPE 1 PRINTER (T1P)

MASS MEMORY (MM)

DYNAMIC SITUATION DISPLAY (DSD)

DIGITAL COMMUNICATIONS
TERMINAL (DCT)

BATTERY BOX (BB)

MASS STORAGE DEVICE
(MSD)

FIRE DIRECTION SURVEY
CALCULATOR (FDSC)

POWER MODULE (PM)

STAR COUPLER (SC)

DIGITAL COMMUNICATIONS
EQUIPMENT (DCE)

19

(U)   This chart illustrates the MIFASS equipment components (exclusive of cables, panels, radios, communications security [COMSEC] equipment, and shelters) at a direct support (DS) battalion (Bn) fire direction center (FDC). The equipment is arranged in the form of two nearly identical "strings," each capable of supporting a forward or rear echelon into which the center divides in order to move. When a move is initiated, one echelon continues to operate at the current location while the second is advanced to a new position during center relocation.

(U)   The equipment at the Bn FDC includes a single Mass Storage Device (MSD), fourteen BBs, two PMs, two MMs, two MCs, four DSDs with keyboards, two Type 1 (slow, 40-column) Printers (T1Ps), two Type 2 (fast, 80-column) Printers (T2Ps), four CCPs for voice communications, four Star Couplers, and two DCE devices. The weight of this equipment, without cables, is about 2,050 lb.

(U)   In normal operations, the pairs of Star Couplers of the two strings are redundantly wired together, and the digital equipment of each string is wired to each of the star couplers in that string. Components can be removed and a whole string detached while other equipment is operating. The cables for unsheltered operations of the Bn FDC weigh about 860 lb. About 90 percent of the cable weight is for power cables (not including prime power from the PM to the generator or other power source). The total weight of the equipment at the Bn FDC is 2,910 lb (see Table 3B.5a1 in Appendix E).

(U)   The equipment at the Bn Fire Support Coordination Center (FSCC) for Marine Corps maneuver elements includes only two DSDs, five T1Ps, no T2P, no MSD, and eight BBs. The MIFASS equipment at the Bn FSCC weighs about 2,030 lb, of which about 630 lb is for cables.

(U)   According to recent data on the Engineering Development Model (EDM) provided by the developer,[1] the storage space for cables for unsheltered centers is 180 ft^3 for Bn FDC and 135 ft^3 for Bn FSCC.

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[1](U) SPAWAR, *Response to IDA Request for Data on MIFASS*, 10 October 1986, UNCLASSIFIED.

MIFASS EQUIPMENT FOR DS BN FDC

STRING 2

STRING 1

MASS
STORAGE
DEVICE

POWER
MODULE

BATTERY
BOX

MASS
MEMORY

MICRO-
COMPUTER

DYNAMIC
SITUATION
DISPLAY

TYPE 1
PRINTER

TYPE 2
PRINTER

STAR
COUPLERS

DIGITAL
COMMUNICATIONS
EQUIPMENT

COMMUNICATIONS
CONTROL PANEL
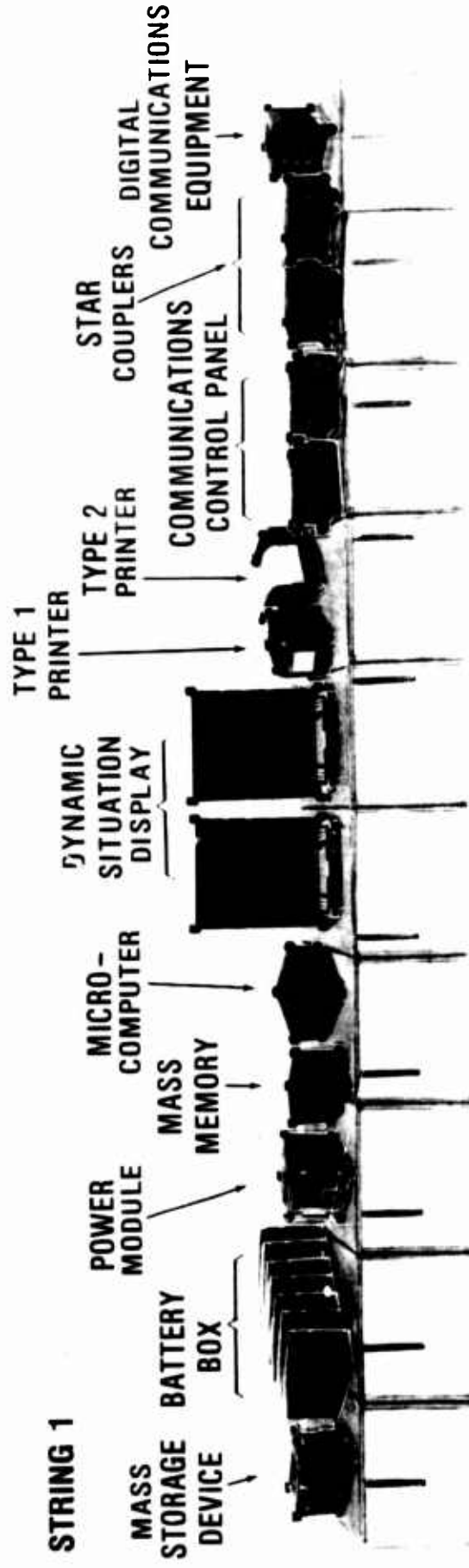
MIFASS EQUIPMENT WEIGHT IS 2050 lb + 860 lb FOR CABLES + COMSEC EQUIPMENT
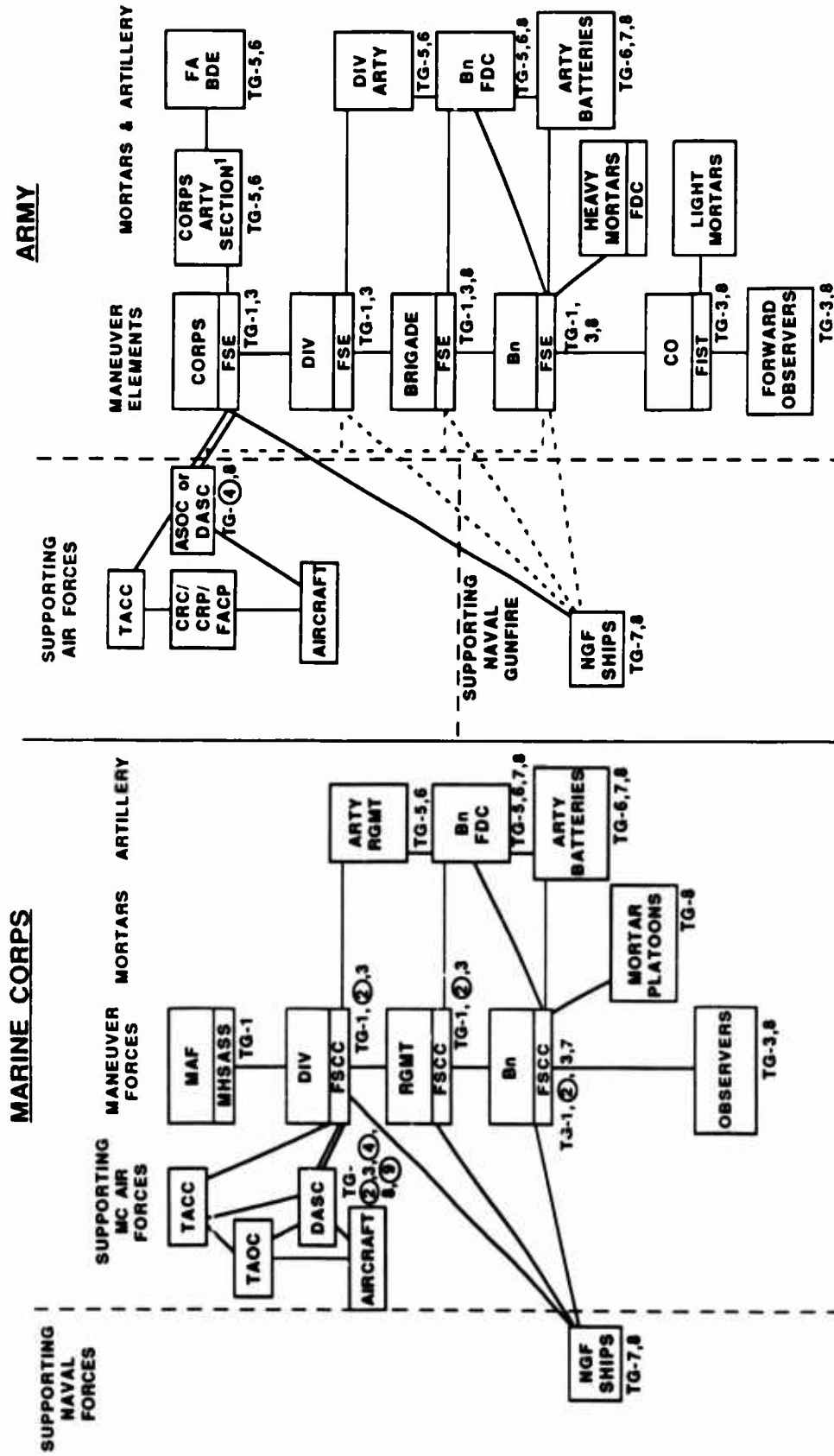
21

10-2-86-1

(U)   This chart shows the principal organizational facilities involved in fire support coordination for a typical combined arms operation in the Marine Corps (MC) and the Army. It also indicates the major functional groups of tasks normally performed at the various Army operational facilities (OPFACs) or Marine Corps command, control, and intelligence elements (C2IEs). These tasks are outlined in the next chart and discussed in Appendix A. In both organization and associated tasks, there are similarities and differences, the most significant of which are discussed below.

(U)   Organic to the Marine Air-Ground Task Forces are both ground forces and air assets sufficient to provide a greater degree of air support than is usually provided to the Army ground forces. In addition, the Direct Air Support Center (DASC) is an integral part of the Marine concept for integrated combined arms employment. Further, Marine Corps doctrine requires that air and ground assets be precisely and positively coordinated by the fire support C2IEs, along with naval gunfire (NGF) and forward area air defense (FAAD) assets (not depicted on the chart). Marine Corps doctrine also requires these combined arms be integrated into maneuver operations. The Army, on the other hand, must rely on the Air Force for its fixed-wing air support, but has an assault helicopter capability organic to the maneuver forces. Ground and air fire support and naval gunfire are coordinated by the Army fire support functional elements. However, the DASC or Air Support Operations Center (ASOC) is operated by the Air Force, while the Army FAAD operations and positive airspace control in the combat zone are performed in functional areas other than fire support. Finally, the Marine Corps has no equivalent organizations to the Army Corps or Armored Cavalry Regiment and does not employ rockets or ground-to-ground missiles.

(U)   Three task groups (TGs) are performed only by fire support organizations in the Marine Corps or Air Force; these are circled on the chart. In tube/air conflict processing (TG-2) for the Marine Corps, each proposed weapon-to-target trajectory is checked for possible conflicts with flight legs of scheduled air missions. The Army, on the other hand, establishes safe corridors in the Army airspace through which air missions are routed; projectile fire is kept out of these restricted spaces. Another Marine-Corps-only task is air support processing (TG-4), whereby the DASC generates coordinated air plans, performs helicopter control, provides aircraft direction, and performs flight path profiling. For the Army, these air support tasks are performed in the Air Force DASC or ASOC, usually collocated with the Tactical Operations Center (TOC) of the corps that it supports. The third Marine-Corps-only task is integrating FAAD into the fire support coordination process (TG-9), by providing automatic message links to FAAD personnel and disseminating air defense situation and status reports as needed. In the Army, this task is supported by the air defense functional area.

FIRE SUPPORT ORGANIZATIONS AND ASSOCIATED TASKS

ARMY

MANEUVER ELEMENTS

MORTARS & ARTILLERY

- FA BDE TG-5,6
- CORPS ARTY SECTION[1] TG-5,6
- DIV ARTY TG-5,6
- Bn FDC TG-5,6,8
- ARTY BATTERIES TG-6,7,8
- HEAVY MORTARS FDC
- LIGHT MORTARS
- CORPS FSE TG-1,3
- DIV FSE TG-1,3
- BRIGADE FSE TG-1,3,8
- Bn FSE TG-1,3,8
- CO FIST TG-3,8
- FORWARD OBSERVERS TG-3,8

SUPPORTING AIR FORCES

- TACC
- ASOC or DASC TG-④,8
- CRC/CRP/FACP
- AIRCRAFT

SUPPORTING NAVAL GUNFIRE

- NGF SHIPS TG-7,8

MARINE CORPS

MANEUVER FORCES

MORTARS

ARTILLERY

- MAF MHSASS TG-1
- ARTY RGMT TG-5,6
- Bn FDC TG-5,6,7,8
- ARTY BATTERIES TG-6,7,8
- MORTAR PLATOONS TG-8
- DIV FSCC TG-1,②,3
- RGMT FSCC TG-1,②,3
- Bn FSCC TG-1,②,3,7
- OBSERVERS TG-3,8

SUPPORTING MC AIR FORCES

- TACC
- TAOC
- DASC TG-②,3,④,8,⑤
- AIRCRAFT

SUPPORTING NAVAL FORCES

- NGF SHIPS TG-7,8

[1] In the AFATDS concept, names would be Corps Artillery CP, Division Artillery CP, and Battalion CP. Corps-controlled rockets and missiles are not shown because there are no comparable Marine Corps systems.

NOTE: TG and numbers refer to list of task groups on the next page. Circled numbers indicate tasks done by Marine Corps or Air Force, but not by Army. To avoid clutter, many communications paths are not shown. For example, during fire missions, the various observers (and forward air controllers) are in contact with weapon delivery means. Double lines connect facilities that are usually collocated but separate.

23

LS-10/28/86-1

(U)   This chart identifies the nine fire support task groups used in the previous chart on organizations and associated tasks. A detailed discussion of the task groups, including three not shown on this chart, is provided in Appendix A.   The primary fire support task groups are briefly described below.

TG-1   Fire Support Control and Coordination provides overall supervision of all fire support means in support of maneuver operations, integrating naval gunfire, offensive air support, mortars, offensive electronic warfare, field artillery, and other available fire support means into the overall force's scheme of maneuver.

TG-2   Tube/Air Conflict Processing is performed by Marine Corps to guarantee that trajectories of artillery and mortar shells do not intersect flight paths of scheduled air missions.

TG-3   Target Generation and Processing develops and maintains a target list. It also includes target value analysis and prioritization when required (Army only).

TG-4   Air Support Processing supports air mission planning and execution (Marine Corps only) .

TG-5   Field Artillery (FA) Tactical Operations supports the management of field artillery delivery units and sensors, including preparation of plans, maintenance of status, coordination of movement, support of meteorological and survey operations, and preparation of fire orders.

TG-6   FA Support and Sustainment provides functions necessary to logistically and administratively support the FA systems.

TG-7   Technical Fire Direction supports generation of firing data for cannon (or mortar) delivery systems and maintains current status of fire missions.

TG-8   Support of Observer Operations integrates the forward observer into the process of carrying out observed fire missions. Tasks include transmitting fire missions, receiving reports, and making subsequent adjustments.

TG-9   Forward Area Air Defense (FAAD) provides message link to FAAD personnel and disseminates situation and status reports as needed by fire support elements (Marine Corps only).

24

FIRE SUPPORT TASK GROUPS

1. FIRE SUPPORT CONTROL AND COORDINATION

2. TUBE/AIR CONFLICT PROCESSING

3. TARGET GENERATION AND PROCESSING

4. AIR SUPPORT PROCESSING

5. FIELD ARTILLERY TACTICAL OPERATIONS

6. FIELD ARTILLERY SUPPORT AND SUSTAINMENT

7. TECHNICAL FIRE DIRECTION

8. SUPPORT OF OBSERVER OPERATIONS (INCLUDING FIRE MISSION EXECUTION)

9. FAAD SUPPORT

25

(U)   In the past 11 years, IDA has conducted and participated in many studies involving Army tactical command and control and its associated tactical data systems. Of the nine shown here, the first two are currently ongoing.

- Army Tactical Command and Control Information System (ATCCIS/OSD/Phase I, IDA P-1668, July 1982).[1]   Phase II, sponsored by SHAPE, is an effort by the armies of the nations of the Central Region to define an ATCCIS that they can commonly develop and utilize in their corps, divisions, and brigades by the year 2000.

- NATO Defense Research Group - Command Function Survivability (-/OSD/-). A multinational effort to identify ways to improve the survivability of the command function on the battlefield (e.g., dispersing the elements of the command post).

- Independent Review of the Army Tactical Command and Control System (-/OSD/IDA M-107, August 1985). Provided a strategy for improving the development and fielding of automated support for the Army's five battlefield functional areas and force level control, which includes centralizing the management, exploiting Ada, and using a single distributed network of computers to support all five functional areas and force level control.

- Information Exchange Requirements (IERs) for Field Artillery ADP Systems in NATO Central Region (-/OSD/IDA P-1502, October 1981). At the request of SHAPE and AFCENT and with the support of the nations in the Central Region of NATO, IDA developed the information exchange requirements for artillery units participating in multinational forces in the Central Region. These requirements form the basis for STANAG 5620, "Standards for the Interoperability of Fire Support ADP Systems."

- NATO Defense Research Group - C3 for Land Operations 2000 (LO 2000 C3/OSD/-). A multinational effort to identify technology areas that the nations could support and that promised to significantly increase C3 capabilities on the battlefield by the year 2000.

- NATO Long-Term Defense Program - Task Force 6 (Command and Control) (-/OSD & OJCS/-). As one of nine task forces set up in 1977 by the Heads of State of the NATO member nations, Task Force Six's effort was to define the C2 portion of the long-term defense program for NATO.

- Systems Options for Improving Joint Tactical C3 Capabilities (SOJTC3/OJCS/Phase 1, IDA R-261, August 1981; Phase 2, IDA R-276, August 1984; Phase 3, IDA R-287, August 1985). The study reviewed the current C3 survivability and interoperability problems in the NATO Central Region and Korea, and the current and planned U.S. programs to alleviate them; it identified the shortfalls and described programmatic options to alleviate the shortfalls.

- Joint Tactical Command and Control (JTC2/OSD & OJCS/IDA R-248, September 1980). A review of the sensor, communications, and ADP systems supporting the U.S. and NATO commanders in the Central Region to provide guidance on integrating these systems to permit the commanders to make more effective use of the available forces and weapon systems.

- Interoperability of Tactical Data Systems (ITADS/OSD & OJCS/IDA R-228, December 1976). A study of the tactical data systems being developed by the four Services to identify interoperability problems and their potential solutions.

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[1] (U) Acronym/DoD Sponsor/Date IDA report published.

SOME IDA ONGOING AND COMPLETED C2 STUDY EFFORTS

- ARMY TACTICAL COMMAND AND CONTROL INFORMATION SYSTEM (ATCCIS)

- NATO DEFENSE RESEARCH GROUP - COMMAND FUNCTION SURVIVABILITY

- INDEPENDENT REVIEW OF THE ARMY TACTICAL COMMAND AND CONTROL SYSTEM

- IER FOR FIELD ARTILLERY ADP SYSTEMS IN NATO CENTRAL REGION

- NATO DEFENSE RESEARCH GROUP - C3 FOR LAND OPERATIONS 2000

- NATO LONG-TERM DEFENSE PROGRAM - TASK FORCE ON COMMAND AND CONTROL

- SYSTEM OPTIONS FOR IMPROVING JOINT TACTICAL C3 CAPABILITIES

- JOINT TACTICAL COMMAND AND CONTROL (JTC2)

- INTEROPERABILITY OF TACTICAL DATA SYSTEMS (ITADS)

27

LS-16-28

(U)   This section describes how the analysis was approached, whom the study team visited, what assumptions were used in conducting the study, what options were actually analyzed, what facets of each option were examined, and what the major issues of the study were found to be.

28

STEPS IN THE ANALYSIS

- **APPROACH**

- **VISITS AND MEETINGS**

- **ASSUMPTIONS**

- **TRANSLATION OF STATED OPTIONS INTO ANALYZED OPTIONS**

- **AREAS ANALYZED**

- **MAJOR ISSUES**

29

LS-15-19

(U)   Upon receiving the tasking for the study, the study team first developed a methodology for approaching the problem and a preliminary set of issues for each of the options to be analyzed. Although refined several times, the original methodology and issues provided initial direction for the project.

(U)   The next step was to locate, obtain, and analyze relevant documents. Once a preliminary set of data had been established, the team began to visit and meet with responsible organizations as noted in the next chart.

(U)   On 7 October 1986, the Army and Marine Corps provided the required decision briefings to OSD on the subject of which system(s) need to be developed. In the original tasking it was anticipated that the study team could make an independent assessment using the information provided by the Services in these briefings. Actually very little detailed information of use to the study team was contained in these briefings. However, considerable information was obtained from subsequent meetings with each of the Services (USMC on 10 October 1986 and U.S. Army on 17 October 1986) on the background material that was used as the basis for each of the briefings.

(U)   To reduce the possibility of basing its findings on incorrect information, the study team reviewed its data base (now contained in Appendixes A to E) with the users and developers of each Service prior to establishing its final conclusions and recommendations. The USMC and U.S. Army reviews were held on 12 and 13 November 1986, respectively. Attending each review were the Project Manager (PM) and representatives from all the organizations (except testing) identified in the next chart for that Service. Agreed-to data from these meetings were used to update the data base.

30

APPROACH

31

BW(10-3)2
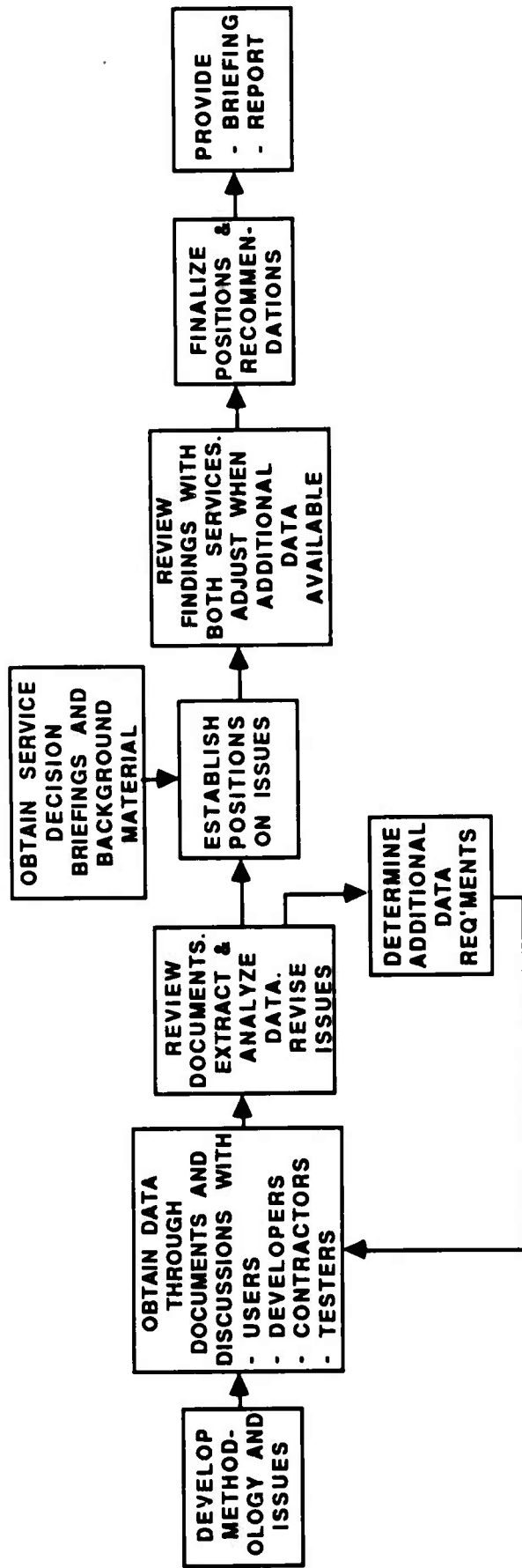
(U)   As shown on this chart, the study team met with all Service organizations, contractors, and manufacturers that have a major function in the development, testing, and fielding of the two systems under analysis. For AFATDS the user/sponsor is the U.S. Army Training and Doctrine Command (TRADOC) System Manager (TSM) for Fire Support C3 (FSC3) located at the U.S. Army Field Artillery School (USAFAS). The AFATDS developer at the Communications-Electronics Command (CECOM) is the PM Field Artillery Tactical Data Systems (FATDS) under the PM for the Army Command and Control System (PM ACCS). The Operational Test and Evaluation Agency (OTEA) is responsible for testing. The MIFASS user/sponsor is the Acquisition Sponsor Project Officer (ASPO) in Headquarters, Marine Corps (HQMC). The Marine Corps Development and Education Command (MCDEC) is the MIFASS developer, and the U.S. Navy Space and Naval Warfare Systems Command (SPAWAR) is the developer's agent and the procurer of the system. MCDEC, SPAWAR, and the First Marine Amphibious Force (1 MAF) Test Directorate support MIFASS testing. The study team also met with other major organizations that expressed an interest in such discussion, e.g., U.S. Army Deputy Chief of Staff for Operations and Plans (DCSOPS), U.S. Army Deputy Chief of Staff for Research, Development, and Acquisition (DCSRDA), and HQMC Installations and Logistics (I&L).

(U)   As part of the visits, the study team operated and examined the developmental equipment. At Norden Systems, the team operated the MIFASS system in the laboratory environment, looked inside some of the MIFASS boxes and examined some of the circuit boards from these boxes. At Camp Pendelton, the team operated the MIFASS equipment in the field setting as it was being readied for operational testing (OT II).

(U)   At Magnavox, the team operated the AFATDS CEP equipment in its laboratory environment. A militarized FST, including the keyboard and display, were then completely disassembled and the boards and other components examined to ascertain consistency with existing company technical brochures. The team also observed the manufacturing and assembly of the Army's Fire Support Team (FIST) Digital Message Device (DMD) on the Magnavox assembly line. The FIST DMD is being manufactured to full MILSPEC requirements. Its parts could then be compared to those of the FST.

(U)   At the Army's Field Artillery School at Ft. Sill, OK, the team operated the Tactical Fire Direction System (TACFIRE) equipment. The study team also had discussions with other computer system manufacturers, including IBM and Rolm.

32

VISITS AND MEETINGS

	ARMY	MARINE CORPS
USER/SPONSOR	USAFAS (TSM-FSC3)*	HQMC-CCA (ASPO)
DEVELOPER	CECOM (PM FATDS)	MCDEC (DPO)/SPAWAR
EQUIPMENT	CECOM (PM ACCS)	SPAWAR
TESTING	OTEA	1 MAF TEST DIRECTORATE* MCDEC/SPAWAR
OTHER SERVICE	DCSOPS (FISO) DCSRDA (DASC)	HQMC I&L (APO)
SERVICE CONTRACTORS	CALCULON	CALCULON
MANUFACTURERS	MAGNAVOX*	NORDEN*
OTHER MANUFACTURERS		

*OPERATED EQUIPMENT

33

UNCLASSIFIED

LS-16-1

(U)   The basic assumptions made in the analysis are shown on this chart.   First, the study tasking did not include an assessment of the Service's statements of requirements for their respective systems.   In each case the requirements are spelled out in several documents.   When taken in chronological order, these documents provide the published set of requirements for the two systems.   For example, both Services have organizational and operational (O&O) plans, statements of required operational capability (ROC), and A-level (system) specifications.   In addition, the Marine Corps has a Top-Level Requirements Document for Implementation of MIFASS in Current Organization and Procedures, while the Army has a draft Software Maturation Plan and a Fire Support Automation Plan that indicate the Army's intentions for future versions of AFATDS software and plans for fielding AFATDS.

(U)   When the Secretary of Defense (SECDEF) directed the undertaking of this evaluation, he called for "maximum cross-Service commonality and interoperability" (a copy of the letter is provided in Appendix F).   The study interpreted this direction to mean that the job, in part, was to explore opportunities to achieve that objective, and to provide recommendations in that direction which are also consistent with the support requirements of the Services.

(U)   As has already been noted, both systems have multiple configurations: research and development (R&D), initial operational capability (IOC), and objective.   Therefore, it was necessary to select the appropriate configuration of the respective systems to be compared.   Neither of the developmental versions, CEP for AFATDS and EDM for MIFASS, appears to be fieldable as currently designed.   On the other hand, the characteristics of the objective systems are somewhat less defined.   Therefore, the IOC versions of the systems were selected as the configurations to be used for comparisons in this study.

(U)   Finally, it has been assumed that the tasking intended that the analysis of the three stated options examine the use of the systems as they are currently designed.   That is, they should be usable by the other Service without modification.   However, it was further assumed that the tasking intended that the modifications (and to the degree possible the cost of the modifications), which are required to adapt the system to the other Service, need to be described.

34

ASSUMPTIONS

- SERVICE FUNCTIONAL NEEDS ARE AS STATED IN THE LATEST O&Os AND ROCs AND AS INTERPRETED IN THE DOCUMENTATION LEADING TO THE SYSTEM SPECIFICATIONS

- RECOMMENDATIONS MUST SATISFY SECDEF'S STATEMENT OF 18 APRIL 1986 FOR "MAXIMUM CROSS-SERVICE COMMONALITY AND INTEROPERABILITY"

- IOC CONFIGURATIONS TO BE USED FOR COMPARISON TO GREATEST EXTENT POSSIBLE

- OPTIONS 1, 2, AND 3 DO NOT PERMIT CHANGES TO HARDWARE OR SOFTWARE IN EITHER PROGRAM. HOWEVER, SYSTEM MODIFICATIONS TO MEET THE OTHER SERVICE REQUIREMENTS SHOULD BE DESCRIBED
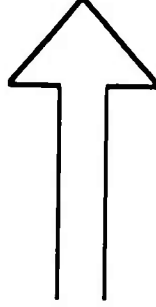
UNCLASSIFIED

BW(10-3)7

(U) This study analyzed the three decision options in depth.

(U) Each of the three decision options consists of two suboptions; some of the suboptions are identical. The suboptions are as follows:

Option 1:

    a. Army fields MIFASS

    b. Marine Corps fields MIFASS

Option 2:

    a. Army fields AFATDS

    b. Marine Corps fields AFATDS

Option 3:

    a. Army fields AFATDS

    b. Marine Corps fields MIFASS.

(U) Eliminating duplication among the suboptions leaves four different suboptions to be analyzed. As shown in the chart, these are identified as Options 1, 2, 3A, and 3B in the analysis. The results of the analysis are reported in the following sections, and the information used in the study for these options are contained in the appendixes. During the analysis of Options 1 and 2, the modifications required to make one system meet the needs of the other Service were identified.

TRANSLATION OF STATED OPTIONS
INTO ANALYZED OPTIONS

STATED OPTIONS

1. BOTH SERVICES FIELD MIFASS

2. BOTH SERVICES FIELD AFATDS

3. ARMY FIELDS AFATDS AND
   MARINE CORPS FIELDS MIFASS

ANALYZED OPTIONS

1. ARMY FIELDS MIFASS
   (AND MODIFICATIONS REQUIRED)

2. MARINE CORPS FIELDS AFATDS
   (AND MODIFICATIONS REQUIRED)

3A. ARMY FIELDS AFATDS
3B. MARINE CORPS FIELDS MIFASS

37

BW(10-3)14

(U)   This chart shows the areas examined in the analysis.   Detailed results of this analysis will be found in the tables in Appendixes A through E.   The areas in the upper part of the chart were identified as issues in the options, and separate tables were prepared to document the results.   The areas at the bottom of the chart were not identified as separate issues. However, these areas were examined, and the results have been included in the appropriate tables.

AREAS ANALYZED

RESULTS SHOWN IN SEPARATE TABLES

PROGRAM STATUS
SYSTEM WEIGHTS
SYSTEM SIZES
SYSTEM COSTS
SYSTEM FUNCTIONAL CAPABILITIES
SYSTEM SCHEDULES
EQUIPMENT MILITARIZATION
PRODUCTION RISKS
MODIFICATIONS FOR OPTIONS 1 & 2

SYSTEM INTERFACES
ORGANIZATIONS, DOCTRINE, AND PROCEDURES
TACFIRE REPLACEMENT
ARMY LIGHT DIVISION REQUIREMENTS
COMMON HARDWARE/SOFTWARE CONCEPTS
POTENTIAL FOR MODERN SYSTEMS
USER REQUIREMENTS
EQUIPMENT CAPABILITIES

ALSO INCLUDED WITHIN THE TABLES

DEGREE OF AUTOMATION
MAN-MACHINE INTERFACES
MILSPEC REQUIREMENTS
TECHNOLOGY
NDI EQUIPMENT
ACCS ACQUISITION STRATEGY

39

(U)   All the areas shown on the previous chart have some bearing on the desirability or practicality of selecting among the decision options. However, the major issues involve whether or not the systems as currently designed can meet the functionality required by the other Service. If not, the question becomes the extent to which system modifications are required to adapt the system to the needs of the other Service. In addition, the equipment weight and program costs of the various options are examined. The remaining major issues are the risks associated with each Service trying to develop and field its own system, and the risks associated with each Service adapting and fielding the system of the other Service.   Each of these major issues is addressed in the following charts.

40

MAJOR ISSUES

- WHAT ARE THE DIFFERENCES IN THE EQUIPMENT WEIGHTS FOR THE THREE OPTIONS?

- WHAT ARE THE DIFFERENCES IN THE COSTS OF THE THREE OPTIONS?

- CAN CURRENT SYSTEMS MEET OTHER SERVICE'S REQUIREMENTS? IF NOT, WHAT MODIFICATIONS ARE NECESSARY?

  - FOR MIFASS TO MEET ARMY NEEDS - OPTION 1
  - FOR AFATDS TO MEET MARINE CORPS NEEDS - OPTION 2

- WHAT MAJOR RISKS ARE ASSOCIATED WITH IMPLEMENTING THE OPTIONS?

LS-19-6

(U) This section summarizes the results of the study. As indicated in the previous chart, the summary addresses four issues: weight, cost, system modifications required to meet Service needs, and risks.

(U) The potential impact of the three options on equipment weight is discussed using the battalion fire direction center as an example. The effect on the weights for other centers of each Service is similar to the effect in this example.

(U) Two charts are used to discuss the impact of the options on cost. In the first chart, AFATDS equipment is based on the most rugged version of the equipment to be procured by the Army under the ACCS program. The second chart, on the other hand, is based on the Marine Corps' using a militarized version of the NDI equipment that is being used in the Army's CEP. Each chart identifies the savings or increased costs for each Service under the various decision options.

(U) The next two charts summarize the extent to which each system cannot meet the requirements of the other Service. Whenever possible, the scope of the modifications required to make a system meet the needs of the other Service is discussed in these charts. Details for these results are contained in Appendixes B and C.

(U) Risks are discussed in four separate charts, one for each of the options analyzed. The first two of these charts identifies risks associated with one Service fielding the system of the other Service. The other two charts discuss risks that are inherent in the programs as currently structured for each Service to field its own system.

RESULTS

- WEIGHT COMPARISON

- COST COMPARISON

- COST COMPARISON WITH MILITARIZED NDI HARDWARE

- MODIFICATIONS TO MIFASS TO MEET ARMY NEEDS

- MODIFICATIONS TO AFATDS TO MEET MARINE CORPS NEEDS

- SOME RISKS IN ARMY FIELDING MIFASS

- SOME RISKS IN MARINE CORPS FIELDING AFATDS

- SOME ADDITIONAL RISKS IN ARMY FIELDING AFATDS

- SOME ADDITIONAL RISKS IN MARINE CORPS FIELDING MIFASS

43

(U)   This graph shows the weight of the equipment (excluding communications) for the three options for a battalion (Bn) fire direction center (FDC). In both systems, the Bn FDC weights have been found to be representative of the weights of centers in the entire force. It should be noted that the Army and Marine Corps employ a different number of workstations at a Bn FDC: three workstations for the Army and four for the Marine Corps in each option. Therefore, the chart provides a basis for comparing the impact of the three options for each Service, but it does not provide a basis for comparing centers in the Marine Corps against centers in the Army.

(U)   The data labeled Option 3 shows the weight of the current systems. In the case of AFATDS, a range of weight estimates is shown, as the equipment has not yet been selected. The range is based on a review of requirements from multiple sources and on the CEP equipment (Table 3A.5a, Appendix D). The lower weight estimate is based on the lowest values found; generally, they were the _maximum_ equipment weights the AFATDS user defined as acceptable. The upper level of the range results from using the maximum weights found. Generally, the higher values were associated with the equipment in the draft ACCS RFP.
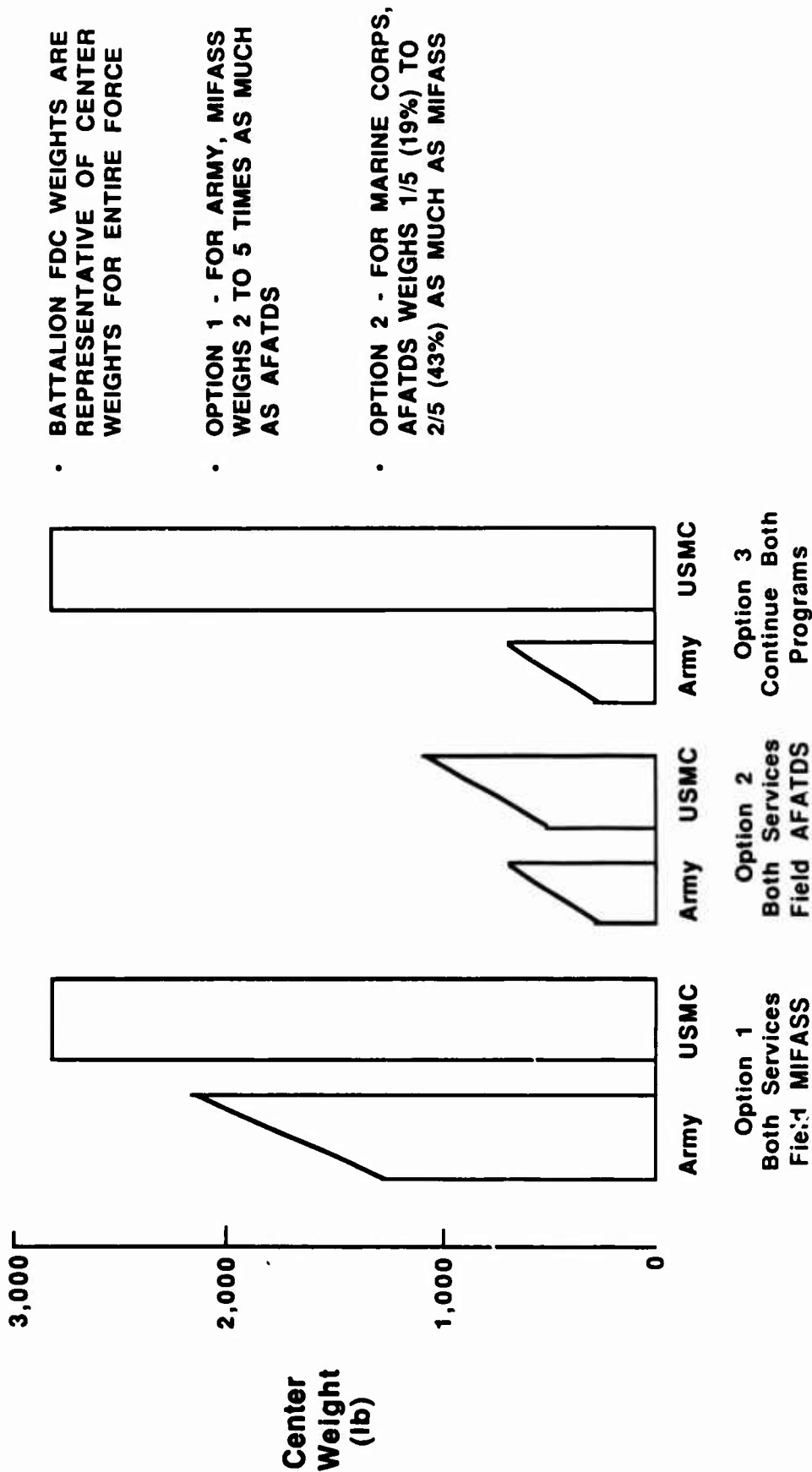
(U)   In developing the equipment weights for Options 1 and 2, the number of workstations for each center for each Service was held constant. Any additional equipment required to support those workstations was added to each center. Tables 1.3b (Appendix B) and 2.3a (Appendix C) provide detailed configurations for Options 1 and 2, respectively.

(U)   In Option 1 (Army fields MIFASS), the variation in weight shown is due to the uncertainity as to whether the Army would populate its centers with one string of equipment or two strings as the Marine Corps does. The lower and upper edges of the column are the weights for the one- and two-string approaches, respectively. (The Army configurations for both edges have three workstations.) As can be seen, MIFASS for the Army would weigh between two and five times as much as AFATDS (Table 1.3a, Appendix B).

(U)   In Option 2 (Marine Corps fields AFATDS), the variations are due to the lack of specific knowledge of the weight of the AFATDS components as noted above. With the current range, AFATDS for the Marine Corps would weigh from 19 to 43 percent as much as MIFASS (Table 2.3a, Appendix C). It should be noted that this range of weights for the AFATDS equipment includes the ruggedized CEP equipment. This equipment has been designed so that MILSPEC components could be employed to produce a MILSPEC version. Such a version would meet militarization requirements similiar to those required by the Marine Corps.

44

WEIGHT COMPARISON

WEIGHT OF BATTALION FDC

- BATTALION FDC WEIGHTS ARE REPRESENTATIVE OF CENTER WEIGHTS FOR ENTIRE FORCE

- OPTION 1 - FOR ARMY, MIFASS WEIGHS 2 TO 5 TIMES AS MUCH AS AFATDS

- OPTION 2 - FOR MARINE CORPS, AFATDS WEIGHS 1/5 (19%) TO 2/5 (43%) AS MUCH AS MIFASS

Center
Weight
(lb)

3,000

2,000

1,000

0

Army   USMC

Option 1
Both Services
Field MIFASS

Army   USMC

Option 2
Both Services
Field AFATDS

Army   USMC

Option 3
Continue Both
Programs

45

LS-17-48B

(U) This chart (and the next) compare costs of the three options based on two different versions of AFATDS. In this chart the AFATDS equipment is based on the most rugged version to be procured by the Army under the ACCS program. In the next chart, Marine Corps costs are based on militarized NDI equipment described later. As in the previous chart, the configurations for Options 1 and 2 have the same number of workstations in the centers for each Service as for Option 3. For the Army, the total force has 3,520 workstations; for the Marine Corps, the total force has 339 workstations.

(U) The cost comparison was done in the following manner. Using program costs provided by the Services at the 7 October 1986 briefings, the equipment component costs were extracted with the help of the program cost personnel. These component costs were then used to determine the cost of the equipment necessary to populate the centers of the other Service as already noted. In Option 1, factors used by the Marine Corps for MIFASS (including a 90-percent learning curve) were applied to account for quantity. All costs have been translated to constant FY 87 dollars for ease of comparison (Tables 3A.8a to 3A.8d in Appendix D and Tables 3B.9a to 3B.9c in Appendix E).

(U) In Option 1, in which the Army fields MIFASS, the variation is due to the uncertainty of whether the Army would use one or two strings per center as discussed in the previous chart. At first glance it might appear that the variation is less than one would expect. Since all of the required workstations (e.g., three for the Army and four for the Marine Corps FDC) as well as all the equipment necessary to support these workstations are already included in the one-string case, only a small amount of additional equipment is required for the two-string case. Further, only one string is configured in the two cases at the lowest echelons, where more than 25 percent of the equipment is located. Thus, the total cost of the additional equipment, where required, to provide two strings per center is only $300,000. On the other hand, the weight of this extra equipment, for example Battery Boxes, provides the larger variation shown in the previous chart. An additional $50 million was provided in the Option 1 upper bound for the Army to account for uncertainty in R&D required to implement the additional functional capabilities. As can be seen, it would cost the Army $1.4 billion to $1.7 billion more to field MIFASS than to field AFATDS under the current program of about $500 million. This is an increase of about 280 to 340 percent.

(U) In Option 2, in which the Marine Corps fields AFATDS, part of the variation is due to the uncertainty in the R&D that might be needed to adapt the AFATDS system to the Marine Corps needs; thus, the lower value shown contains no addition for this R&D, while the higher value contains $50 million. No other values in the MIFASS program costs were altered. As can be seen, under the above rules it would cost the Marine Corps $310 million to $380 million less to field AFATDS than to field MIFASS under the current program of about $450 million. This is a decrease of about 70 to 85 percent.

COST COMPARISON[a]
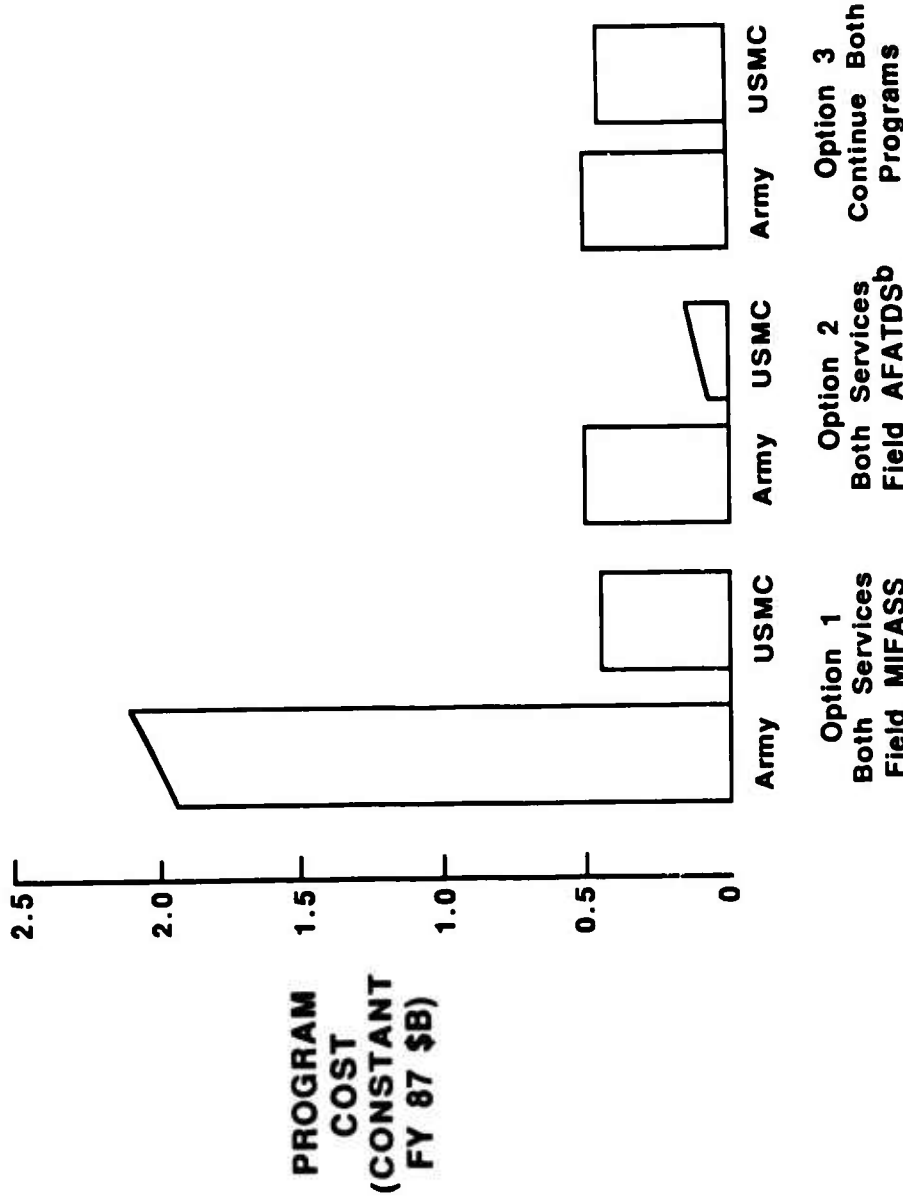
COST OF FIELDING TOTAL FORCE

- BASED ON COST FACTORS PROVIDED BY SERVICES

- IN OPTION 1, FIELDING MIFASS COSTS ARMY $1.4 B TO $1.7 B MORE THAN CURRENT PROGRAM ($500 M), AN INCREASE OF 280% TO 340%

- IN OPTION 2, FIELDING AFATDS COSTS MARINE CORPS $310 M TO $380 M LESS THAN CURRENT PROGRAM ($450 M), A DECREASE OF 70% TO 85%

PROGRAM COST (CONSTANT FY 87 $B)

2.5 — 2.0 — 1.5 — 1.0 — 0.5 — 0

Army   USMC
Option 1
Both Services
Field MIFASS

Army   USMC
Option 2
Both Services
Field AFATDS[b]

Army   USMC
Option 3
Continue Both
Programs

[a] RDT&E and Other Procurement (OP) expenditures for 1987 and beyond in constant FY 87 dollars, for a comparable number of workstations.

[b] Using the most rugged version of Army AFATDS equipment to be provided under ACCS program.

UNCLASSIFIED

47

LS-17-48D

(U)   As explained previously, the cost of the equipment for the Marine Corps was for the most rugged equipment that the Army is planning to buy under the ACCS program. This may not be sufficiently militarized for use by the Marine Corps, since the Army plans to shelterize its equipment while the Marine Corps, at least at the lower echelons, does not.
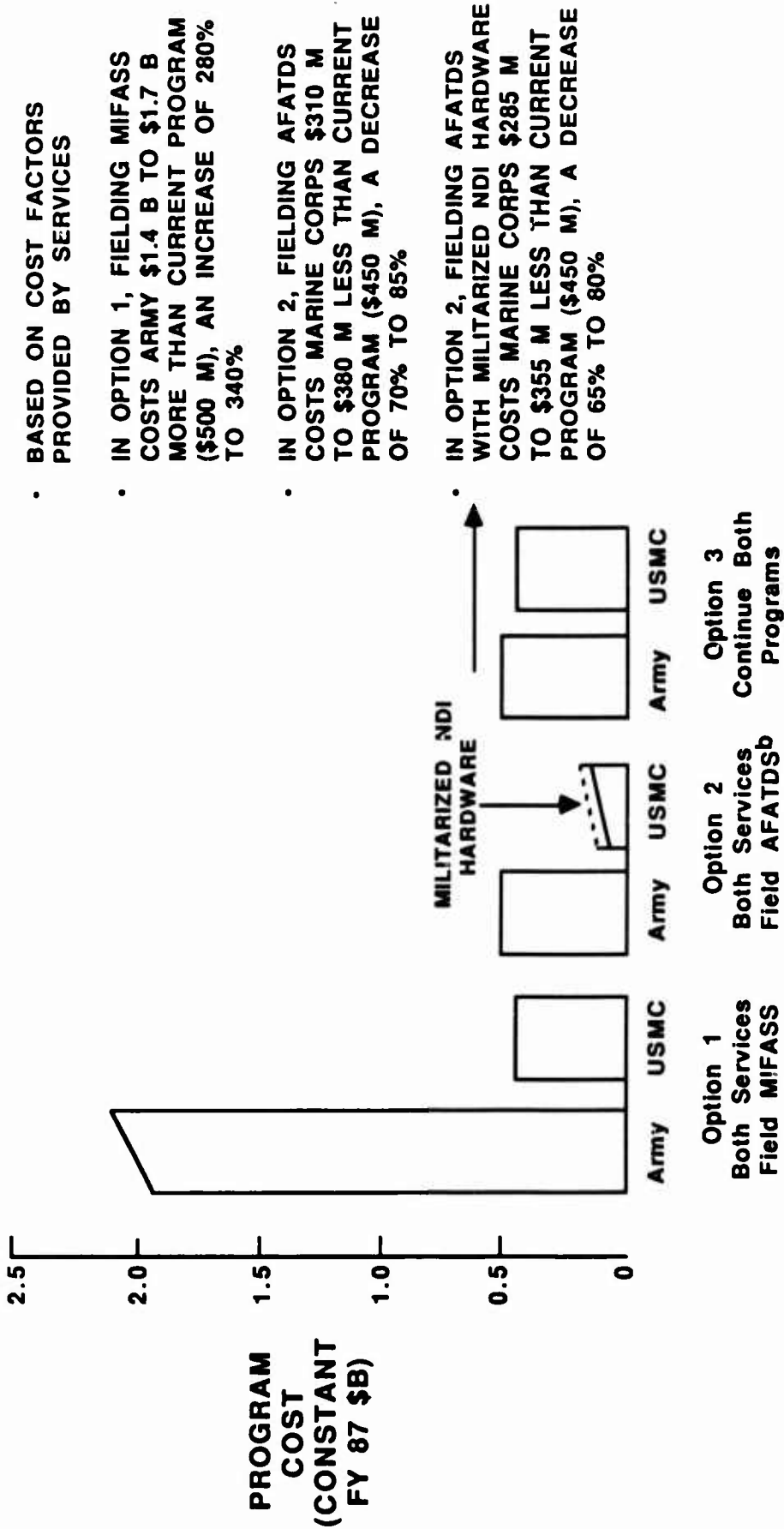
(U)   To prepare a cost estimate involving additionally militarized equipment, the study team visited Magnavox, the builder of the Army's CEP equipment. A review of the Magnavox non-developmental item (NDI) equipment, as previously noted, showed that it was designed to meet most if not all of the Marine Corps militarization requirements; however, the CEP equipment is not being manufactured to all of these requirements. This review included operating the equipment, taking it apart, examining the circuit boards, inspecting the structure, and visiting the FIST DMD production line. The visit to the FIST DMD production line allowed the study team to compare the construction and circuit boards used in the AFATDS CEP equipment with that of the FIST DMD, which is full MILSPEC and currently in production for the Army. It also allowed the team to see the difference in complexity between the FIST DMD and the Magnavox NDI fire support terminal (FST). These data, along with the actual cost of the FIST DMD in quantity (827 at $32,000 each), provide a reasonable data point in estimating the cost of this type of equipment for the Marine Corps.

(U)   The cost estimate shown by the dashed lines in this chart was constructed by replacing the costs used for the ACCS ruggedized equipment with that provided for the Magnavox NDI equipment. Since some of the Marine Corps equipment will be shelterized, the increased militarization may not be required for the whole force. However, the exact amount of equipment to be shelterized could not be determined and, therefore, total use of militarized NDI hardware was assumed and the added cost may be too high. The amount of equipment in all of the centers remained the same. As can be seen, the total difference for the Marine Corps to use the militarized NDI equipment for the whole force is about $25 million, an increase of 18 to 36 percent above the cost of the ACCS ruggedized equipment. This approach would still cost $285 million to $355 million less than the current program; this is a decrease of about 65 to 80 percent.

COST COMPARISON[a]

COST OF FIELDING TOTAL FORCE

- BASED ON COST FACTORS PROVIDED BY SERVICES

- IN OPTION 1, FIELDING MIFASS COSTS ARMY $1.4 B TO $1.7 B MORE THAN CURRENT PROGRAM ($500 M), AN INCREASE OF 280% TO 340%

- IN OPTION 2, FIELDING AFATDS COSTS MARINE CORPS $310 M TO $380 M LESS THAN CURRENT PROGRAM ($450 M), A DECREASE OF 70% TO 85%

- IN OPTION 2, FIELDING AFATDS WITH MILITARIZED NDI HARDWARE COSTS MARINE CORPS $285 M TO $355 M LESS THAN CURRENT PROGRAM ($450 M), A DECREASE OF 65% TO 80%

PROGRAM COST (CONSTANT FY 87 $B)

2.5
2.0
1.5
1.0
0.5
0

MILITARIZED NDI HARDWARE

Army   USMC   Army   USMC   Army   USMC

Option 1   Option 2   Option 3
Both Services   Both Services   Continue Both
Field MIFASS   Field AFATDS[b]   Programs

[a] RDT&E and Other Procurement (OP) expenditures for 1987 and beyond in constant FY 87 dollars, for a comparable number of workstations.

[b] Solid line assumes use of the most rugged version of Army AFATDS equipment to be provided under ACCS program. Dotted line assumes use of militarized NDI hardware.

49

UNCLASSIFIED

LS-17-48C

(U)   This chart summarizes the modifications that would need to be made to MIFASS for it to meet the Army's needs. Three areas are addressed: functions to be added, tailoring to the Army's way of doing business, and hardware changes. In estimating the magnitude of the task of adding AFATDS functions, it is necessary to know that the Army plans to initially field AFATDS in two software versions.

(U)   Version 1 of the AFATDS software is to be provided to the light divisions and III Corps in FY 90, and Version 2 is to be provided to the other corps and divisions starting in FY 91. Norden Systems has estimated the number of MIFASS lines of code (LOC) that would be required in MIFASS to provide the AFATDS Version 1 functions. The estimates are: in communications, 53,000 LOC to add AFATDS interface requirements; in fire support execution, 10,000 LOC to add automated target nomination, and 5,000 LOC to add automated checks of fire support coordination measures; in fire planning, 12,000 LOC to add sensor analysis and guidance, 30,000 LOC to add deferred MIFASS automation, and 40,000 LOC to add deferred automated execution; 15,000 LOC to add movement control; and 15,000 LOC for miscellaneous software changes. The total estimate for these changes is 180,000 lines of CMS-2 code. The total number of lines of code currently in the MIFASS system is 158,000. Thus, these changes represent a software effort that exceeds the MIFASS software completed to date. At $300 per line of code (a cost estimating factor used by Calculon, the MIFASS support contractor), these changes to MIFASS software would cost $54 million.

(U)   Norden has not yet provided a similar estimate of the impact of providing the Version 2 functions. However, in the AFATDS program it has been estimated that an additional 600,000 lines of Ada code will be required beyond Version 1 to provide the Version 2 functions for the AFATDS system.

(U)   In regard to modifying the MIFASS software to accommodate Army organization, doctrine, procedures, and operator-machine interface, the degree to which the changes contained in the Norden estimate would tailor the MIFASS software to the Army's way of doing business is not known; in any case, the software must be modified to reflect such things as the Army organization, Army operational facility names, message routings, and the operator-machine interface.

(U)   As previously described, the weight of MIFASS exceeds the expected weight of AFATDS by a considerable amount. Assuming that would be unacceptable to the Army, MIFASS would have to be reengineered to reduce its weight. Also, the Army uses a display with a much smaller screen than that contained in MIFASS. The study team was informed by the Marine Corps that it had looked at small-screen displays and that one could be provided for MIFASS without significant difficulty.

50

MODIFICATIONS TO MIFASS TO MEET ARMY NEEDS

CURRENT MIFASS DESIGN WILL NOT SATISFY ARMY REQUIREMENTS. MODIFICATIONS NEEDED.

- **ADD AFATDS FUNCTIONS**

  - VERSION 1 FUNCTIONS INCLUDING AUTOMATION OF TARGET NOMINATION, FIRE PLANNING, FSCM CHECKS, AND FIRE PLAN EXECUTION; SENSOR ANALYSIS AND GUIDANCE; MOVEMENT CONTROL; AND ARMY INTERFACE REQUIREMENTS. [NORDEN ESTIMATE 180,000 LOC (CMS-2); THIS WOULD BE $54 M AT $300/LOC]

  - VERSION 2 FUNCTIONS INCLUDING NUC/CHEM, DEEP BATTLE, QUERY CONTROL LANGUAGE, TARGET VALUE ANALYSIS, AND CORPS-LEVEL REQUIREMENTS

- **MODIFY SOFTWARE TO ACCOMMODATE ARMY ORGANIZATION, DOCTRINE, AND PROCEDURES, AND OPERATOR-MACHINE INTERFACE**

- **REENGINEER HARDWARE TO REDUCE WEIGHT; PROVIDE SMALL-SCREEN DISPLAY**

51

UNCLASSIFIED

(U) This chart summarizes the modifications required for AFATDS to meet the Marine Corps needs. Four areas are addressed: functions to be added, interfaces to be added, tailoring to the Marine Corps' way of doing business, and militarization.

(U) The four Marine Corps-unique functions that would have to be added are shown on the chart. According to Norden Systems, there are 28,200 lines of CMS-2 coding in MIFASS that implement these functions. The Army has estimated that it would take no more than 40,000 lines of Ada code to implement these functions in AFATDS. Magnavox, in coordination with the Army, has estimated that it would cost about $3 million to develop and test Ada coding to provide these functions in AFATDS.

(U) The estimates above do not include the effort required to provide interfaces unique to the Marine Corps. The Marine Corps obtains information on its own unit positions directly from a Position Location Reporting System (PLRS) master station. The Marine Corps also plans to obtain the air picture from the Tactical Air Operations Module (TAOM) via a TADIL B tactical data link. Since these two interfaces are not included in AFATDS, they would need to be added. For the Marine Corps to use AFATDS, AFATDS would also have to interface with the Landing Force Integrated Communications System (LFICS). The major interface required would be to the Unit-Level Message Switch (ULMS).

(U) The AFATDS software would have to be modified to tailor the system to the Marine Corps operations including the names of the Marine Corps operational facilities, the MIFASS messages, and the message routings. The Marine Corps operator-machine interface would also need to be added, as the Marine operators expect to touch the screen to hook targets and fire units, while in the Army system these functions tend to be automated.

(U) From the requirements, it can be seen that the Marine Corps has more stringent hardware militarization requirements than the Army. This is in part due to the lack of shelters in the lower-echelon units in the Marine Corps. Although Service representatives agreed that equipment at these lower echelons must be "militarized," no study could be found that specified the degree of militarization required for this type of equipment for either Service.

52

MODIFICATIONS TO AFATDS TO MEET MARINE CORPS NEEDS

CURRENT AFATDS DESIGN WILL NOT SATISFY MARINE CORPS REQUIREMENTS. MODIFICATIONS NEEDED.

• ADD MIFASS FUNCTIONS [ARMY ESTIMATES 40,000 LOC (Ada); MAGNAVOX ESTIMATES $3 M]

  - AIR SUPPORT PROCESSING AND PROCEDURAL DIRECTION
  - POSITION LOCATION INFORMATION PROCESSING
  - FORWARD AREA AIR DEFENSE
  - TUBE/AIR CONFLICT

• ADD INTERFACES TO MARINE CORPS' PLRS AND TAOM (TADIL B)

• ADD COMMUNICATIONS INTERFACE HARDWARE AND SOFTWARE NECESSARY TO USE MARINE CORPS' LANDING FORCE INTEGRATED COMMUNICATIONS SYSTEM

• CHANGE SOFTWARE TO ACCOMMODATE MARINE CORPS ORGANIZA-TION, DOCTRINE, AND PROCEDURES, AND OPERATOR-MACHINE INTERFACE

• POSSIBLY INCREASE MILITARIZATION OF HARDWARE

53

LS-19-8

(U) The following four charts describe risks associated with each Service fielding its own system (Option 3), as well as each Service fielding the system of the other Service (Options 1 and 2). Two of the risk areas in fielding MIFASS to the Army are shown on this chart. They are the fielding schedule and the processing and memory requirements.

(U) Preproduction and production efforts for fielding MIFASS will take 6 years according to the current schedule (IOC in FY 93). A proposed accelerated schedule would reduce this to 5 years (IOC in FY 92). The AFATDS schedule is based on fielding equipment to the light divisions and III Corps in FY 90 and to the other corps and divisions starting in FY 91. Thus, even with the accelerated schedule, MIFASS cannot meet the Army's fielding schedule.

(U) The Army requires 6 to 8 times the equipment required by the Marine Corps (Table 1.8 in Appendix B). Unless accounted for early on, this magnitude of increase could overwhelm the production capability of the MIFASS vendors.

(U) The Army Brigade (Bde) Fire Support Element (FSE) has a requirement to support up to eight fire plans at one time. Each fire plan has two courses of action; each course of action has four options. A data base on the order of 57 MB is necessary to contain these fire plans as well as the additional data necessary to carry out the other functions of the center. The IOC version of the MIFASS Mass Memory is to have up to 8 MB. Thus, each of the Brigade FSEs would require eight MIFASS Mass Memories.

(U) All Army field artillery units except battery and the Bn FSE for light divisions are to be equipped with at least one FSCT and two FSTs. Corps Main, Division Main, and the Bde FSE also have this same equipment. An FSCT has three 32-bit processors, while an FST has one, not counting those processors devoted to the displays. Thus, a typical Army center would have five 32-bit processors. Some have more; for example, Corps Artillery (Arty) has 11 processors and Division Arty has 6. A MIFASS microcomputer, of which there are usually two per center in the configurations used in this study, has a single 16-bit processor.

(U) It is clear from the above that the memory and processing requirements of the Army centers greatly exceed the MIFASS capability envisioned for the Marine Corps centers. Clearly additional memory units would be required. However, in the case of the AFATDS processing capability, it is not clear whether the total number of processors at each center was determined by the need for processing power or the need to equip a given number of workstations using a minimum number of different processor configurations. For this reason, it has not been possible to determine the impact of these requirements on a design of MIFASS for the Army, and that impact has not been taken into account in the configurations used in this study.

54

SOME RISKS IN ARMY FIELDING MIFASS

- **UNCERTAIN IMPACT ON ARMY FIELDING SCHEDULE**

  - MIFASS CANNOT BE FIELDED IN ARMY TIME FRAME (AFATDS FIELDING TO LIGHT DIVISIONS FY 90. MIFASS IOC FY 92/93).

  - GREATLY INCREASED MIFASS PRODUCTION REQUIREMENTS (ARMY REQUIRES 6 TO 8 TIMES THE EQUIPMENT REQUIRED BY MARINE CORPS).

- **IMPACT OF PROCESSING AND MEMORY REQUIREMENTS ON COST AND WEIGHT**

  - ARMY FIRE SUPPORT CENTERS HAVE DATA BASES OF UP TO 57 MB. WOULD REQUIRE 8 MIFASS MASS MEMORIES (IOC VERSION).

  - TYPICAL AFATDS CENTER HAS 5 32-BIT PROCESSORS. SOME HAVE AS MANY AS 11. A MIFASS COMPUTER HAS 1 16-BIT PROCESSOR.

55

LS-19-9

(U) Some of the risks of fielding AFATDS to the Marine Corps are shown on this chart. Three areas are addressed: software status, hardware uncertainty, and ease of adaptation.

(U) The AFATDS software is being completed in stages called versions and releases. The CEP version, which is estimated to be 750,000 lines of Ada code, is scheduled to progress to formal testing in 2Q FY 87. The most recent release of this coding, Release 3, which contained 460,000 LOC or about 60 percent of the CEP total, was tested in August 1986. Testing consisted of nearly 5,000 separate tests and produced only 40 trouble reports. Several Army sources who witnessed this testing verified that the testing went very smoothly. The vendor has given considerable credit for this success to Ada and its programming rules. The CEP version of the software (referred to as Release 4) is expected to contain most of the basic fire support functions needed by the Marine Corps except as noted in the modifications discussed previously. By the end of 3Q FY 87, it should be known whether or not Release 4 will test as satisfactorily as did Release 3.

(U) There is a risk that the hardware to be selected by the Army will not fit the Marine Corps needs in the area of ruggedization. This selection is not due for about another year. However, there is NDI equipment that would appear to meet at least most of the Marine Corps requirements. An example of this would be the militarized version of the hardware the Army is using in its CEP. This hardware, although manufactured for CEP with less ruggedization because the requirement is less, is designed to meet MILSPEC requirements that nearly match those of the Marine Corps.

(U) The study team heard a number of times how the AFATDS software has been designed to be adaptable to changing requirements and how this would make it easy to adapt AFATDS to the Marine Corps needs. However, this adaptability has not yet been demonstrated.

SOME RISKS IN MARINE CORPS FIELDING AFATDS

- THE AFATDS SOFTWARE THAT THE MARINE CORPS WOULD NEED IS NOT YET COMPLETE. HOWEVER,

  - THE LAST RELEASE CONSISTED OF 460,000 LOC. FORMAL TESTING PRODUCED ONLY 40 TROUBLE REPORTS

  - FORMAL TESTING OF FINAL RELEASE FOR CEP (750,000 LOC) BEGINS 2Q FY 87

- THE HARDWARE THAT THE ARMY IS GOING TO FIELD HAS NOT YET BEEN SELECTED. HOWEVER, NDI HARDWARE (FOR EXAMPLE, MILITARIZED VERSION OF CEP HARDWARE) WOULD APPEAR TO MEET MOST OF THE MARINE CORPS NEEDS

- THE EASE OF ADAPTING AFATDS TO SATISFACTORILY EXECUTE MARINE CORPS FUNCTIONS HAS NOT YET BEEN DEMONSTRATED

57

LS-19-16

(U) This chart notes some of the additional risks in fielding AFATDS to the Army. Two areas are discussed: additional software to be developed and hardware selection.

(U) The Version 2 software is that which is to be fielded to the corps and divisions starting in FY 91. The AFATDS program estimates that 600,000 LOC will be required to provide the additional functions beyond the brigade capabilities to be tested during the CEP. Version 2 will then consist of about 1,350,000 LOC, which is almost double the current size. This would represent the largest Ada C2 program known to be currently in development. The sheer size of this effort could bring about difficulties in managing its development, integration, test, and verification.

(U) Results of this study would indicate that the AFATDS hardware risk is more one of schedule than capability. However, a substantial hardware risk does exist, due to the items shown on the chart. That is, the AFATDS hardware requirements are to be finalized using the results of the CEP. AFATDS will use a mix of ACCS NDI and AFATDS-unique hardware, but the ACCS RFP is not due out until 2Q FY 8; ..d the selection of the ACCS components is not scheduled until 1Q FY 88. Following that selection, AFATDS can determine what ACCS equipment it can use and what it has to procure for itself. The schedule for this would appear tight if integration and testing of the IOC system (with Version 1 software) is to be completed by 3Q FY 89 (see Table 3A.7 in Appendix D and the schedule charts in Appendix F).

58

SOME ADDITIONAL RISKS IN ARMY FIELDING AFATDS

- **SOFTWARE VERSION 2 FOR IOC REQUIRES 1,350,000 LOC (Ada), AN ADDITION OF 600,000 LOC BEYOND CEP**

- **HARDWARE NOT YET IDENTIFIED**

  - HARDWARE REQUIREMENTS TO BE FINALIZED FOLLOWING CEP
  - USES MIX OF ACCS NDI AND AFATDS-UNIQUE HARDWARE
  - ACCS RFP DUE 2Q FY 87
  - ACCS COMPONENT SELECTION SCHEDULED FOR 1Q FY 88
  - AFATDS-UNIQUE EQUIPMENT PROCUREMENT FOLLOWING ACCS COMPONENT SELECTION

59

LS-19-10

(U)   This chart notes some additional risks in fielding MIFASS to the Marine Corps.

(U)   A significant risk area is represented by the large amount of software still to be developed for MIFASS after the operational test and the production decision. At least 60,000 to 70,000 additional lines of CMS-2 code are planned for initial development with research, development, test, and evaluation (RDT&E) funds and for completion with procurement funds. About $49 million is budgeted for this development and the associated testing. A large fraction of the effort is associated with developing required interfaces, including the Battery Computer System (BCS), Meteorological Data System (MDS), and Firefinder TPQ-36. The TADIL B interface for the Tactical Air Operations Module (TAOM) is not included in the estimate of 60,000 to 70,000 LOC. The scope of the additional software is about 40 percent of the entire software developed to date for the EDM.

(U)   Two other risk areas are the communications and processing loads to support dissemination of position location information (PLI) within MIFASS. Currently, the Marine Corps plans to use a single point of entry for PLRS data using a device (MIFASS PLRS Interface Controller) that is not yet fully developed (a rugged version is not available). IDA has not been able to find any studies of the communication loading to support internal transfer of PLRS data within MIFASS, but some discussions have indicated this load may be more than 90 percent of the total load.[1] A related issue is whether the 16-bit AN/AYK-14 microprocessor can keep up with the data rates provided by PLI inputs from both PLRS and TADIL B

(U)   Another issue is how difficult and expensive integrated logistics support will be over the life of the system, since the design reflects 1979 technology while the initial operational capability is 1992 or 1993. Spare parts could be difficult to obtain during the MIFASS life cycle.

(U)   An additional risk is that the system may be too cumbersome for field operations by the Marine Corps—this issue may be resolved by the MIFASS operational test. The weight and complexity of MIFASS configurations may not satisfy the Marine Corps overall operational requirements. This risk, however, should be understood to some degree after the OT II tests results have been completed. However, some risks will remain if the MIFASS equipment is unavailable for futher operational testing or field experience prior to the planned deployment in 1992 or 1993.

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[1](U) Discussions with Marine Corps and contractor personnel, September to November 1986, UNCLASSIFIED.

SOME ADDITIONAL RISKS IN MARINE CORPS FIELDING MIFASS

- **MORE THAN 60,000 TO 70,000 ADDITIONAL LOC REQUIRED (40% OF CURRENT SOFTWARE EFFORT)**

- **CAN TACTICAL COMMUNICATIONS SUPPORT PLI TRANSFER REQUIREMENTS?**

- **CAN TWO TO SIX 16-BIT PROCESSORS PER CENTER KEEP UP WITH PLRS AND TADIL-B INPUTS FOR POSITION LOCATION INFORMATION?**

- **WILL SPARE PARTS FOR A 1979 DESIGN BE AVAILABLE FOR LIFE OF EQUIPMENT REACHING IOC IN 1993?**

- **MAY BE TOO CUMBERSOME**

61

LS-104-2

(U)   The next five charts summarize the conclusions and observations of this study.   The first four charts provide findings for the four analyzed options.   The last of these charts provides comments applicable to all the options.   Appendixes B through E contain detailed data and additional findings for each of the four analyzed options.

CONCLUSIONS AND OBSERVATIONS

63

LS-18-3

(U) This chart relates to Option 1, in which both Services field MIFASS. The conclusions and observations shown are those related to fielding MIFASS to the Army; other findings for fielding MIFASS to the Marine Corps are given in a subsequent chart summarizing Option 3B.

(U) The general finding is that, without modification, MIFASS will not meet the Army requirements as currently stated. MIFASS as it is currently developed could not support nuclear and chemical operations, nor would it provide the degree of automation the Army requires to meet its high intensity threat (Table 1.1 in Appendix B). Several major interfaces could not be provided, including eight that are part of the TACFIRE system as currently planned (Table 1.2).

(U) Army command posts and fire support elements would weigh 1.4 to 5.8 times as much with MIFASS hardware as with AFATDS. The range is 1.4 to 5.0 if only a single string of MIFASS equipment is used. For a division equivalent (one sixty-fifth of the total force), the factors are 1.8 to 5.3 (Table 1.3).

(U) MIFASS could not provide the Army a significant improvement over TACFIRE, which is already deployed to heavy divisions. MIFASS equipment appears to be too heavy for the light divisions and, unmodified, would not contain some major functions already available in TACFIRE.

(U) Based on RDT&E and procurement program data for the configurations included in this study, Option 1 could quadruple the cost of the Army program, increasing it from $0.5 billion to $1.9-2.2 billion. This is an increase of $1.4-1.7 billion. Further, Option 1 would delay the Army IOC and add substantial risks to the Army plans to build its objective system. The latter is the result of the limitations in MIFASS to provide substantial increases of processing power and memory capacity at reasonable costs and without greatly increasing configuration complexity and weight.

64

CONCLUSIONS AND OBSERVATIONS

OPTION 1 - BOTH SERVICES FIELD MIFASS

- **WITHOUT MODIFICATION MIFASS WILL NOT MEET ARMY REQUIREMENTS**

- **WEIGHT OF MIFASS FOR ARMY WOULD BE 2 TO 5 TIMES THAT OF AFATDS**

- **MIFASS DOES NOT PROVIDE FOR THE ARMY A SIGNIFICANT IMPROVEMENT OVER TACFIRE**

  - DOES NOT CONTAIN SOME MAJOR ARMY FUNCTIONS INCLUDED IN TACFIRE
  - TO PROVIDE SAME NUMBER OF WORKSTATIONS PLANNED USING AFATDS, MIFASS EQUIPMENT FOR A LIGHT DIVISION WOULD WEIGH 40 TO 90 PERCENT MORE THAN TACFIRE EQUIPMENT

- **OPTION 1 WOULD QUADRUPLE THE COST OF THE ARMY PROGRAM (ADDS $1.4 B TO $1.7 B)**

65

(U) This chart relates to Option 2, in which both Services field AFATDS. Again, the conclusions and observations shown on this chart are for fielding AFATDS to the Marine Corps; other findings related to fielding AFATDS to the Army are shown on the next chart (Option 3A).

(U) The general finding is that, without modifications, AFATDS will not meet the Marine Corps requirements as currently stated. As planned for IOC, AFATDS does not provide automated support for Marine Corps tasks in four major functional areas: air support processing and procedural direction, position location information processing, forward area air defense, and tube/air conflict processing. Two major Marine Corps interfaces are not planned to be supported by AFATDS: PLRS and TAOM (TADIL B). In addition, AFATDS does not currently plan to interface to the Marine Corps Landing Force Integrated Communications System. Further, the AFATDS software does not currently accommodate Marine Corps organization, doctrine, and procedures. It does not currently provide the operator-machine interface, such as screen formats and hooking of targets and fire units, needed to support the Marine Corps' way of conducting fire and air support operations. Some of the modifications required to provide these capabilities for the Marine Corps could be significant. Finally, although it appears that AFATDS could be adapted to the Marine Corps needs, this adaptability needs to be demonstrated.

(U) AFATDS offers the potential of providing significant reductions in the weight and cost of an advanced fire support system for the Marine Corps. The AFATDS configurations developed for this study weigh 19-43 percent as much as the currently planned MIFASS configurations for the Marine Corps. Using the AFATDS configurations would reduce the cost of the Marine Corps program by 65-85 percent or $285-380 million. The lower estimate of this reduction includes estimated costs of militarized NDI hardware and $50 million beyond the currently programmed Army R&D to account for uncertainties in adapting AFATDS to the needs of the Marine Corps.

(U) In addition to these findings, note that the MIFASS IOC is planned for 1992 or 1993, while the IOCs for AFATDS are in 1990 and 1991. This implies a minimal risk for the Marine Corps since there is an additional 1 to 2 years to provide a modified AFATDS system to meet the Marine Corps needs.

66

CONCLUSIONS AND OBSERVATIONS (CONT'D)

OPTION 2 - BOTH SERVICES FIELD AFATDS

- WITHOUT MODIFICATION, AFATDS WILL NOT MEET MARINE CORPS REQUIREMENTS

- IT APPEARS THAT AFATDS COULD BE ADAPTED TO THE MARINE CORPS' NEEDS. ADAPTABILITY NEEDS TO BE DEMONSTRATED

- THE WEIGHT OF AFATDS FOR MARINE CORPS WOULD BE 19 TO 43 PERCENT AS MUCH AS MIFASS

- WITH AN IOC OF 1992/93, AFATDS SCHEDULE RISKS FOR THE MARINE CORPS APPEAR TO BE MINIMAL

- OPTION 2 WOULD REDUCE THE COST OF MARINE CORPS PROGRAMS BY 65 TO 85 PERCENT OR $285-380 M

67

LS-19-12

UNCLASSIFIED

(U) This chart summarizes the conclusions and observations for Option 3A (Army fields AFATDS). Three areas are addressed: acquisition strategy, schedule risk, and funds programmed.

(U) An IDA study done in 1985 at the request of the Under Secretary of the Army addressed the problem of an acquisition strategy for the Army's tactical data systems. Measured by the criteria provided in that study, AFATDS has the potential to field a modern system (Table 3A.2 in Appendix D).

(U) The AFATDS program is essentially a software first, hardware last, program. This is a recent concept in the acquisition of Army tactical data systems, and it should be noted that some things considered risks in a traditional program are inherent in this type of approach. For example, the uncertainty of the equipment suite that currently exists in the AFATDS program is normal in a software first, hardware last approach, but would be of considerable concern in a traditional program.

(U) It appears that there is little time in the schedule for the procurement of the AFATDS-unique equipment, since what is needed will not be completely known until after the ACCS components are selected. Further, it now appears that slippage of the ACCS RFP (from 1Q FY 87 to 2Q FY 87) and subsequent component selection may now be tending to drive the AFATDS schedule (Table 3A.7 in Appendix D).

(U) An examination of three key requirements documents (the AFATDS ROC, the ATCCS ROC written by TRADOC combining user requirements from all five functional areas, and the ACCS RFP) revealed a significant number of differences in equipment ruggedization and capability. However, the study team is aware that the Army is making a concerted effort to bring these documents into alignment (Table 3A.6 in Appendix D).

(U) In reviewing the AFATDS program costs, it was noted that 30-50 percent of the hardware procurement funds were programmed prior to Milestone III, the production decision point in the current acquisition cycle (Table 3A.8 in Appendix D). Although of obvious concern, the actual significance of this could not be established. This is because events like Milestone III are associated with the traditional method of developing and fielding equipment and may not fit the software first, hardware last approach.

68

CONCLUSIONS AND OBSERVATIONS (CONT'D)

OPTION 3A - ARMY FIELDS AFATDS

- **AFATDS ACQUISITION STRATEGY HAS POTENTIAL TO FIELD MODERN SYSTEM**

- **SUBSTANTIAL SCHEDULE RISKS EXIST IN THE AFATDS PROGRAM**

  - SOME RISKS MAY BE CONSISTENT WITH THE ARMY'S NEW APPROACH OF DEVELOPING THE SOFTWARE BEFORE SELECTING THE HARDWARE

  - LITTLE TIME IN SCHEDULE TO PROCURE AFATDS-UNIQUE EQUIPMENT (INITIATED AFTER ACCS AWARD)

  - AFATDS ROC REQUIRES MORE MILITARIZATION THAN ATCCS ROC. ACCS RFP ALIGNED WITH ATCCS ROC; THEREFORE, RFP MAY NOT BE RESPONSIVE TO AFATDS USER NEEDS

- **30 TO 50 PERCENT OF AFATDS HARDWARE PROCUREMENT FUNDS PROGRAMMED PRIOR TO MILESTONE III**

69

LS-17-10

(U)   This chart summarizes the conclusions and observations for Option 3B (Marine Corps fields MIFASS). Two areas are addressed: acquisition strategy and field experience.

(U)   In general, the traditional acquisition approach for tactical data systems has led to systems that are heavier and more costly than equipment available at the time the system is ready to be fielded. Today, however, there are three additional factors that should be taken into account. First, a programming capability exists (Ada) that facilitates the software first, hardware last approach to system acquisition. Second, software (the CEP version of AFATDS) will exist in the near term that will contain the basic fire support functions. This software, since it is written in Ada and designed to be ported to different computers, could be used with hardware suitable to the Marine Corps. Third, the use of the NDI hardware approach could cut years from the normal acquisition cycle.

(U)   When OT II for MIFASS ends early in 1987, only a small percentage of the Marine Corps personnel will have had an opportunity to operate MIFASS in a field environment. Although there is no accepted plan for the use of EDM equipment after the completion of OT II, it appears that the Marine Corps intends to return it to the Norden plant and use it in the preproduction phase. After that, it would be refurbished and become part of the production equipment. Thus, the next opportunity for the Marine Corps to operate MIFASS in an operational setting will not occur until fielding begins in 1992/1993. This represents a 5- to 6-year gap in the Marine Corps' operational knowledge of the system. The study team believes that the Marine Corps could gain valuable field experience with the EDM equipment by placing it in an operational MAB following OT II rather than returning it to Norden.

70

CONCLUSIONS AND OBSERVATIONS
(CONT'D)

OPTION 3B - MARINE CORPS FIELDS MIFASS

- MIFASS ACQUISITION STRATEGY APPEARS TO BE LEADING TO THE FIELDING OF A HEAVIER AND MORE COSTLY SYSTEM THAN COULD BE OBTAINED WITHIN THE DEVELOPMENT AND PRODUCTION TIME FRAME

- THERE IS A 5- to 6-YEAR GAP BETWEEN OT II AND THE START OF FIELDING OF MIFASS

  - THERE IS NO AGREED-TO PLAN FOR EDM EQUIPMENT BEYOND OT II

  - MARINE CORPS COULD GAIN VALUABLE FIELD EXPERIENCE IN THE AUTO-MATION OF FIRE SUPPORT FUNCTIONS BY FIELDING THE EDM EQUIPMENT TO AN OPERATIONAL MAB DURING THIS PERIOD

71

(U) This chart identifies two findings that apply to all the decision options. These are in the areas of militarization requirements and cross-Service commonality.

(U) Neither Service has conducted detailed tests or analytical studies to determine the degree to which equipment for tactical data systems must be militarized to operate effectively on the battlefield. Thus, the Army user does not know what the impact will be of the lower levels of ruggedization implicit in the current ACCS procurement. The Marine Corps is planning to develop its Tactical Combat Operations system with NDI and reduced ruggedization, with similar uncertainty as to the operational impact.

(U) Analyses conducted in this study have shown a number of areas in which there is a potential for some hardware and software to be common across the Services. However, there is no organization charged with the responsibility of ensuring that commonality where possible is actually achieved.

CONCLUSIONS AND OBSERVATIONS (CONT'D)

OTHER

- NEITHER SERVICE HAS CONDUCTED DETAILED TESTS OR ANALYTICAL STUDIES TO DETERMINE THE DEGREE TO WHICH THE TACTICAL DATA SYSTEM EQUIPMENT MUST BE MILITARIZED TO OPERATE EFFECTIVELY ON THE BATTLE-FIELD

- THERE APPEARS TO BE A POTENTIAL FOR SOME OF THE HARDWARE AND SOFTWARE TO BE COMMON ACROSS THE SERVICES. HOWEVER, THERE IS NO ORGANIZATION CHARGED WITH THE RESPONSIBILITY OF ENSURING THAT THIS HAPPENS.

73

LS-17-11/2

(U)   The next four charts contain the study recommendations. They are organized into three groups: Army related, Marine Corps related, and other.

74

RECOMMENDATIONS

75

(U)   This chart contains the Army-related recommendations. The first two recommendations have already been discussed.

(U)   The ACCS definition for NDI equipment, as told[1] to the study team, requires that the equipment be in production and that the Army procure no more than 10 percent of the total production. Discussions with potential suppliers indicate that this approach may not provide the most desirable equipment. For example, the equipment being used by the Army in the CEP would not be considered by ACCS since it is not in production, although the Army will have considerable experience with it. Equipment from suppliers such as Rolm, which supply only NDI equipment, also may be excluded for the same reason. The study team feels that the Army should broaden the ACCS definition of NDI to include technologically advanced equipment, not yet in production, from proven tactical data system suppliers.

(U)   The ACCS program is planning to purchase thousands of items of computer hardware. In addition, the users will be purchasing user-unique equipment. The users have lists showing allocations of equipment to their units. However, an integrated system-level concept for the development and fielding of the equipment for the five functional areas and force-level control does not yet exist. The study team feels that the Army should view the automation being provided to the five functional areas and force-level control as a single system, not as five or six systems that are tied together. Thus, if this approach was taken on a center by center or command post by command post basis, a considerably different equipment configuration may result. For example, the number of interfaces numbers of printers, program load units, and medium- and large-screen displays might all go down. The number of interfaces between the centers or command posts and the outside world might also be reduced. The Army should develop such a system-level concept to ensure that the centers and command posts are being populated and interconnected in an optimum manner.

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[1](U) OPM ACCS, *Briefing to IDA*, 3 September 1986 UNCLASSIFIED; confirmed in discussions with Army at IDA, 13 November 1986, UNCLASSIFIED.

76

RECOMMENDATIONS

ARMY RELATED

- DoD AND THE ARMY SHOULD SUPPORT THE CONTINUATION OF THE AFATDS PROGRAM

- ARMY SHOULD CONTINUE TO WORK TO RESOLVE CURRENT REQUIREMENT INCONSISTENCIES AMONG FIRE SUPPORT USER, TRADOC, PM FATDS, AND PM ACCS

- ARMY SHOULD BROADEN THE ACCS DEFINITION OF NDI TO IN-CLUDE TECHNOLOGICALLY ADVANCED EQUIPMENT NOT YET IN PRODUCTION FROM PROVEN TACTICAL SYSTEM SUPPLIERS

- ARMY SHOULD PREPARE DETAILED, INTEGRATED SYSTEM-LEVEL CONCEPT FOR DEVELOPMENT AND FIELDING OF THE FIVE FUNC-TIONAL AREA SYSTEMS AND FORCE-LEVEL CONTROL SYSTEM UNDER THE ACCS PROGRAM

77

(U) This chart shows the Marine Corps-related recommendations.

(U) First, the MIFASS operational test (OT II) should be completed. There is too much operational information that would be lost if it were not completed.

(U) Second, after completing OT II, the Marine Corps should put the EDM equipment in an operational MAB to gain operational experience with the system.

(U) Third, the Marine Corps should conduct an Adaptability Evaluation Program (AEP) to validate the concept of adapting AFATDS to the Marine Corps needs as well as the potential cost and weight reductions. This test program could use the Army's CEP hardware. (The Army, through OPM FATDS, has agreed to permit the Marine Corps to use this equipment, as long as the Marine Corps test does not interfere with the CEP test itself. This conflict should not arise, since the Army is scheduled to complete its CEP before the Marine Corps could get its test ready).

(U) As envisioned here, the AEP includes modifying the AFATDS CEP software to perform the basic Marine Corps functions and to support the Marine Corps' way of doing business as well as adding the four Marine Corps-unique functions previously discussed. (Marine Corps-unique interfaces are not included in the AEP described here.) Magnavox, in coordination with the Army, has estimated the cost for the total AEP at $4.3 million: $1.3 million for the modifications to the CEP software, and $3 million for adding the Marine Corp-unique functions. Magnavox has indicated that it has the resources, beyond those required to support the AFATDS program, to accomplish the changes and additions and to support a test for the Marine Corps within a 12-month period.

(U) A workstation concept for the AEP is presented on the next chart.

(U) It is recommended that DoD use an "Honest Broker" team to ensure that the Army provides the Marine Corps with all the information and support required to do the test and that the Marine Corps conducts a fair evaluation.

78

RECOMMENDATIONS (CONT'D)

MARINE CORPS RELATED

- DoD AND MARINE CORPS SHOULD SUPPORT COMPLETION OF MIFASS OT II

- MARINE CORPS SHOULD PUT MIFASS EDM EQUIPMENT IN OPERA-TIONAL MAB TO GAIN OPERATIONAL EXPERIENCE WITH SYSTEM

- MARINE CORPS SHOULD CONDUCT TEST OF ADAPTABILITY OF AFATDS TO SUPPORT MARINE CORPS NEEDS AND TO VALIDATE POTENTIAL FOR COST AND WEIGHT REDUCTIONS

  - CONDUCT 12-MONTH ADAPTABILITY EVALUATION PROGRAM (AEP) FOR MAB SLICE

    -- USE AFATDS CEP HARDWARE WITH ONE MSD PER WORKSTATION
    -- MODIFY AFATDS SOFTWARE TO SUPPORT
      --- Hooking of Targets and Fire Units
      --- USMC OPFAC Names
      --- USMC Message Routing
      --- Applicable USMC Messages, Reports, and Small/Medium-Screen Display Presentations
    -- ADD MARINE CORPS UNIQUE FUNCTIONS

  - EMPLOY DoD "HONEST BROKER" TEAM

  - ESTIMATED COST $4.3 M

79

(U)   This chart shows how a combination of AFATDS equipment could be used to achieve the operator-machine interface needed for the AEP, which was previously recommended for determining the adaptability of the AFATDS hardware and software in meeting Marine Corps requirements.   The current MIFASS workstation (Dynamic Situation Display) is on the left.   It has a keyboard and a touch-sensitive screen.   The upper part of the screen is used to display map graphics that appear as overlays to a map inserted behind the screen.   The lower part of the screen is used to display textual messages and status reports.   The Dynamic Situation Display weighs 124 lb.

(U)   On the right is the AFATDS CEP fire support terminal (FST) with its keyboard and small-screen display (SSD).   On top of the FST is the AFATDS medium-screen display (MSD) also being tested in the CEP.   The CEP version of the FST weighs 45 lb; it contains a Motorola 68020 processor, up to 16 MB of random access memory, the local area network, and up to 4 modems.   The CEP version of the MSD weighs 80 lb.   Both the SSD and the MSD are touch-sensitive screens.   The AFATDS MSD is designed also to display map graphics as overlays to a map inserted behind the screen in a manner similar to that of the MIFASS Dynamic Situation Display.
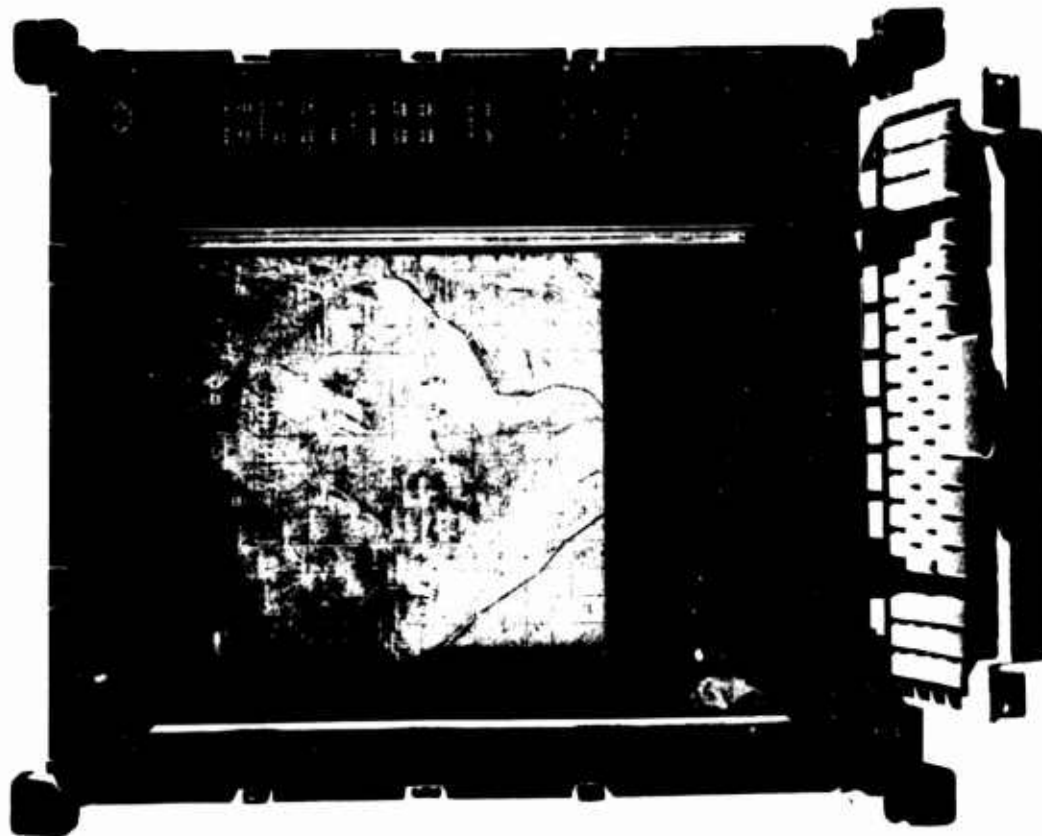
(U)   The basic concept of operation for the AEP workstation is to display the Marine Corps' textual information on the small-screen display of the FST and the graphics information on the medium-screen display.

WORK STATIONS

POTENTIAL FOR AEP
AFATDS CEP
FIRE SUPPORT TERMINAL
(INCLUDES SMALL-SCREEN DISPLAY)
AND MEDIUM-SCREEN DISPLAY

MIFASS
DYNAMIC SITUATION DISPLAY

81
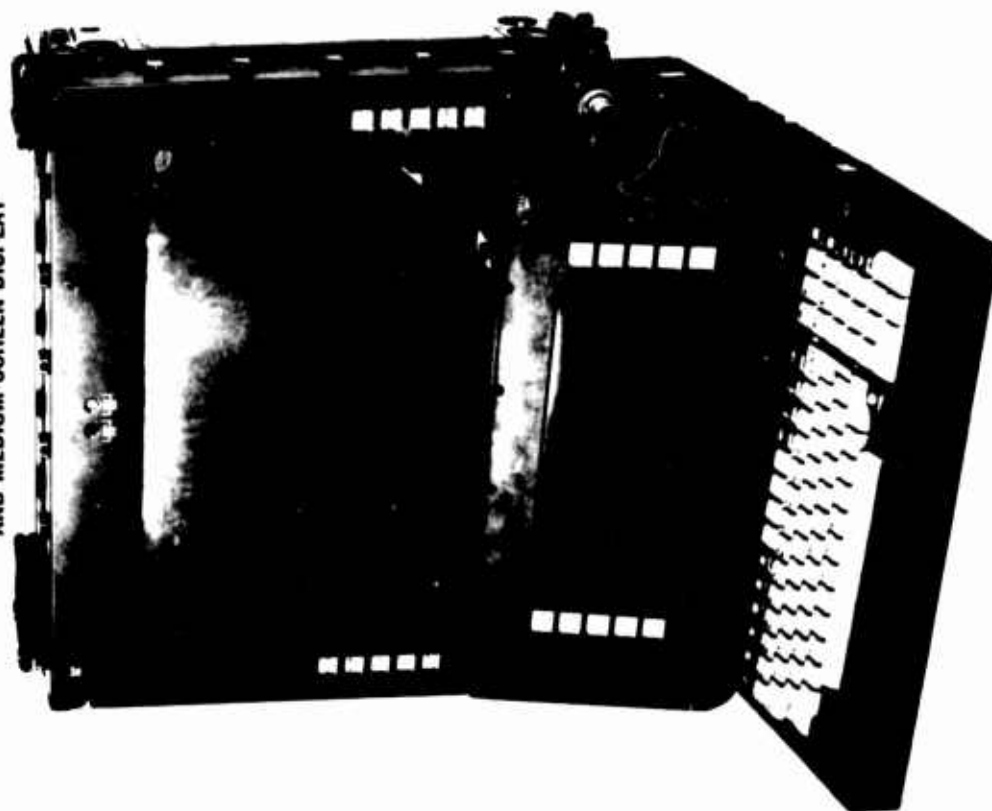
(U)   The Marine Corps should use the results of both the AEP and OT II to generate a detailed plan for the development and fielding of the integrated fire and air support system. Assuming the results of the AEP are positive, the Marine Corps, in coordination with the Army, should supplement and modify the AFATDS software (in Ada) to implement the Marine Corps-unique interfaces. The Marine Corps should select the NDI equipment that most closely fits its needs.

82

RECOMMENDATIONS (CONT'D)

MARINE CORPS RELATED (CONT'D)

- USING THE RESULTS OF THE AEP AND EDM OT II, MARINE CORPS SHOULD GENERATE A DETAILED DEVELOPMENT AND FIELDING PLAN FOR THEIR INTEGRATED FIRE AND AIR SUPPORT SYSTEM. IF RESULTS OF AEP ARE POSITIVE, MARINE CORPS, IN COORDINA-TION WITH THE ARMY, SHOULD

  - SUPPLEMENT AND MODIFY AFATDS SOFTWARE (IN Ada) TO IMPLEMENT MARINE CORPS-UNIQUE INTERFACES

  - PROCURE AFATDS/ACCS/TCO/EUCE HARDWARE TO EXTENT THEY MEET MARINE CORPS NEEDS

  - PROCURE OTHER NDI EQUIPMENT WHERE AFATDS/ACCS/TCO/EUCE HARDWARE DOES NOT MEET MARINE CORPS NEEDS

83

(U)   Two other recommendations apply to both the Army and the Marine Corps.   These recommendations address potential system commonality and militarization requirements.

(U)   DoD should establish a program to ensure that common hardware and software is used across the Services to the maximum extent possible.   One possibility is to use JCS MOP 160[1] as a vehicle for these requirements.   JCS MOP 160 could be modified to include commonality as well as compatibility and interoperability among those areas for which commonality must be assessed and supported when possible.

(U)   JCS MOP 160 addresses all aspects of achieving tactical C3I compatibility and interoperability, such as doctrine and concepts, requirements processing, standards, systems life-cycle management, and training.   In addition, it establishes an improvement program for tactical C3I compatibility and interoperability.   The basis for achieving compatibility and interoperability of tactical C3I systems will be the Joint Tactical C3 Architecture.

(U)   Both Services should individually begin to conduct detailed tests and analytical studies to determine the degree of ruggedization or militarization required to ensure that tactical data systems will operate satisfactorily on the battlefield.   These activities should carefully consider the tradeoffs for using vehicles and shelters to meet some of the environmental requirements.

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[1](U) Joint Chiefs of Staff, *Compatibility and Interoperability of Tactical Command, Control, Communications, and Intelligence System*, Memorandum of Policy No. 160, Third Revision, 7 January 1986, UNCLASSIFIED.

RECOMMENDATIONS (CONT'D)

OTHER

- DoD SHOULD ESTABLISH A PROGRAM TO ENSURE THAT COM-
MON HARDWARE AND SOFTWARE IS USED ACROSS THE SER-
VICES TO THE MAXIMUM EXTENT POSSIBLE. ONE POSSIBILITY
IS TO MODIFY JCS MOP 160 TO INCLUDE COMMONALITY AS WELL
AS COMPATABILITY AND INTEROPERABILITY

- BOTH SERVICES SHOULD CONDUCT REQUISITE DETAILED
TESTS AND ANALYTICAL STUDIES TO DETERMINE THE
MILITARIZATION REQUIRED TO ENSURE THAT TACTICAL
DATA SYTEMS WILL OPERATE SATISFACTORILY ON THE
BATTLEFIELD

85

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(U) This chart summarizes the recommendations of the previous charts.

SUMMARY

RECOMMEND THAT

- AFATDS BE CONTINUED

- MIFASS OT II BE COMPLETED AND THE EDM EQUIPMENT BE PUT IN AN OPERATIONAL MAB

- MARINE CORPS TEST THE ADAPTABILITY OF AFATDS TO MEET ITS NEEDS

- MARINE CORPS PROVIDE A DETAILED DEVELOPMENT AND FIELDING PLAN FOR THEIR SYSTEM BASED ON THE RESULTS OF THE AEP AND THE MIFASS OT

87

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88

GLOSSARY

ACCS	Army Command and Control System
Ada	Designates a DoD-wide standard language for software
ADLER	Artillerie Daten, Lage, und Einsatz Rechnerebund (Federal Republic of Germany Artillery Data Storage and Entry Computer Network)
AEP	Adaptability Evaluation Program
AFATDS	Advanced Field Artillery Tactical Data System
APO	Acquisition Project Officer
Arty	Artillery
ASD	Assistant Secretary of Defense
ASOC	Air Support Operations Center
ASPO	Acquisition Sponsor Project Officer
ATACMS	Army Tactical Missile System
ATCCIS	Army Tactical Command and Control Information System
ATCCS	Army Tactical Command and Control System
ATHS	Airborne Target Handoff System
BATES	Battlefield Artillery Target Engagement System (United Kingdom)
BB	Battery Box (MIFASS)
BCS	Battery Computer System
Bde	Brigade
Bn	Battalion

C2	Command and Control
C2IE	Command, Control, and Intelligence Element
C3	Command, Control and Communications
C3I	Command, Control, Communications, and Intelligence
CAS	Close Air Support
CCP	Communications Control Panel (MIFASS)
CECOM	U.S. Army Communications-Electronics Command (Fort Monmouth, NJ)
CEP	Concept Evaluation Program
CMS-2	A Navy standard computer programming language
Co	Company
COA	Course of Action
COMSEC	Communications Security
CP	Command Post
CTT	Commanders' Tactical Terminal
DA	Decision Aid
DASC	Direct Air Support Center
DCE	Digital Communications Equipment (MIFASS)
DCSOPS	U. S. Army Deputy Chief of Staff for Operations and Plans
DCSRDA	U. S. Army Deputy Chief of Staff for Research, Development, and Acquisition
DCT	Digital Communications Terminal
Div	Division
DMD	Digital Message Device
DoD	Department of Defense
DOS	Disk Operations System
DPO	Development Project Officer

90

DS	Direct Support
DSD	Dynamic Situation Display (MIFASS)
DT	Developmental Testing
DUSD	Deputy Under Secretary of Defense
EDM	Engineering Development Model
EMP	Electromagnetic Pulse
EP	Electronic Printer (AFATDS)
EPLRS	Enhanced Position Location Reporting System
ETAS	Elevated Target Acquisition System
EUCE	End User Computer Equipment
FA	Field Artillery
FAAD	Forward Area Air Defense
FADAC	Field Artillery Digital Automatic Computer
FASC	Fire and Air Support Center
FATDS	Field Artillery Tactical Data Systems
FDC	Fire Direction Center
FDO	Fire Direction Officer
FD/SC	Fire Direction/Survey Calculator (MIFASS, EDM only)
FED	Forward Entry Device
FIST	Fire Support Team
FS	Fire Support
FSCC	Fire Support Coordination Center
FSCT	Fire Support Computer Terminal (AFATDS)
FSE	Fire Support Element

91

FSS	Fire Support System (AFATDS)
FST	Fire Support Terminal (AFATDS)
FSX	Fire Support Execution
FUE	First Unit Equipped
FY	Fiscal Year
GAO	U.S. General Accounting Office
HAEMP	High-Altitude Electromagnetic Pulse
HASC	U.S. House of Representatives Armed Services Committee
HDU	Hard Disk Unit (ACCS)
HIP	Howitzer Improvement Program
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HQ MC	Headquarters, U.S. Marine Corps
HTU	Handheld Terminal Unit (ACCS)
HW	Hardware
I&L	Installations and Logistics
IDA	Institute for Defense Analyses
IER	Information Exchange Requirement
ILS	Integrated Logistics Support
IOC	Initial Operational Capability
IR&D	Independent Research and Development

JCS	Joint Chiefs of Staff
JINTACCS	Joint Interoperability Tactical Command and Control System
JSTARS	Joint Surveillance and Target Acquisition Radar System
LAN	Local Area Network
LCC	Life Cycle Cost
LFICS	Landing Force Integrated Communications System
LOC	Lines of Code
LSD	Large-Screen Display (AFATDS)
LW	Land Warfare
MAB	Marine Amphibious Brigade
MAF	Marine Amphibious Force (contains roughly 3 MABs)
MAGTF	Marine Air-Ground Task Force
MB	Megabyte
MBC	Mortar Ballistics Computer
MC	Marine Corps
MC	Microcomputer (MIFASS)
MCCES	Marine Corps Communications-Electronics School
MCDEC	Marine Corps Development and Education Center (Quantico, VA)
MCLB	Marine Corps Logistics Base
MCMM	Memory Control Module with Memory
MCS	Maneuver Control System
MCTSSA	Marine Corps Tactical Systems Support Activity
MDS	Meteorological Data System
MHSASS	MAGTF Headquarters Supporting Arms Special Staff

93

MIFASS	Marine Integrated Fire and Air Support System
MILSPEC	Military Specification
MLRS	Multiple Launch Rocket System
MM	Mass Memory (MIFASS)
MOP	Memorandum of Policy
MPIC	MIFASS PLRS Interface Controller
MSD	Mass Storage Device (MIFASS)
MSD	Medium-Screen Display (AFATDS)
MTACCS	Marine Tactical Command and Control System
NATO	North Atlantic Treaty Organization
NBC	Nuclear, Biological, and Chemical
NDI	Non-Developmental Item
NGF	Naval Gunfire
NSR	No Stated Requirement
NTDS	Naval Tactical Data System
O&O	Organizational and Operational (Plan)
OASD	Office of the Assistant Secretary of Defense
OP	Other Procurement
OPFAC	Operational Facility
OPLAN	Operations Plan
OPM	Office of the Project Manager
OSD	Office of the Secretary of Defense
OT	Operational Testing

94

OTEA	U.S. Army Operational Test and Evaluation Agency
OUSDA	Office of the Under Secretary of Defense for Acquisition
P3I	Pre-Planned Product Improvement
PCG	Power Converter Group (AFATDS)
PCU	Portable Computer Unit (ACCS)
PLI	Position Location Information
PLRS	Position Location Reporting System
PLU	Program Load Unit (AFATDS)
PM	Power Module (MIFASS)
PM	Project Manager
POM	Program Objective Memorandum
POMCUS	Prepositioning of Overseas Materiel Configured to Unit Sets
R&D	Research and Development
RAM	Random Access Memory
RDT&E	Research, Development, Test, and Evaluation
Regt	Regiment
RFP	Request for Proposal
ROC	Required Operational Capability
RPV	Remotely Piloted Vehicle
SASC	U.S. Senate Armed Services Committee
SC	Star Coupler (MIFASS)
SCP	Single-Card Processor
SDU	Standalone Display Unit (ACCS)

95

SECDEF	Secretary of Defense
SMM	Semiconductor Memory Module
SPAWAR	U.S. Navy Space and Naval Warfare Systems Command
SSD	Small-Screen Display (AFATDS)
STANAG	Standard Agreement
SW	Software
T1P	Type 1 Printer (MIFASS)
T2P	Type 2 Printer (MIFASS)
TACC	Tactical Air Control Center
TACFIRE	Tactical Fire Direction System
TADIL B	A tactical digital information link
TAOC	Tactical Air Operations Central
TAOM	Tactical Air Operations Module (USMC)
TCO	Tactical Command Operations (USMC for maneuver control)
TCU	Transportable Computer Unit (ACCS)
TDA	Target Damage Assessment
TG	Task Group
TLRD	Top-Level Requirements Document
TOC	Tactical Operations Center
TSM-FSC³	TRADOC System Manager, Fire Support Command, Control, and Communications
TRADOC	U.S. Army Training and Doctrine Command (Fort Leavenworth, KS)
TWP	Tactical Warfare Programs
ULMS	Unit-Level Message Switch
USAFAS	U.S. Army Field Artillery School (Fort Sill, OK)

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USDRE	Under Secretary of Defense for Research and Engineering
USMC	U.S. Marine Corps
V2	Version 2 (AFATDS Software that Includes Chemical/Nuclear Functions)
V5	Version 5 (AFATDS Software for Objective System)
VFMED	Variable Format Message Entry Device

97

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APPENDIX A
FIRE SUPPORT TASKS

- FUNCTIONAL TASK GROUPS

- FUNCTIONAL AND AUTOMATION REQUIREMENTS

  AND CAPABILITIES: AFATDS, MIFASS, AND TACFIRE

A-1

(U) The purpose of the charts in this appendix is to compare the required functional capabilities of MIFASS and AFATDS and to contrast these capabilities with those of the TACFIRE system already fielded by the Army. The data in these charts illustrate a very important difference among the systems--the degree of automation support required for the various functional capabilities.

(U) For comparison purposes, fire support tasks have been aggregated into 12 major functional task groups. On subsequent charts, these groups are further broken down into 31 functions. While only a few of the detailed tasks and subtasks are shown (more than 1,000 have been defined by the Army), they illustrate the major differences among the systems. In generating the task breakdown, the AFATDS System Specification[1] was used as a starting point, and the MIFASS-unique tasks were added. This format was chosen 'because this task grouping had been used previously by both system development teams in system comparisons and because documentation was available to determine the planned degree of automation for each task.

(U) On subsequent charts the degree of automation is indicated with one or more of the following six notations:

-   NOT PERFORMED: this task or subtask is not performed by this system or associated fire support personnel.

M   MANUAL: the task is performed entirely or largely manually by staff personnel with little or no help from the system.

I   INTERACTIVE: the operator performs a major part of the task with interactive support by the system.

A   AUTOMATED: the system performs the task automatically based on some predetermined algorithm with little or no intervention from the operator.

DA DECISION AID: the system explores various alternatives based on predetermined decision logic and commander's (operator's) guidance. The system offers alternatives to the operator and recommends the best alternative. The operator accepts the recommendation or selects another alternative.

E   EXPERT SYSTEM: there is a plan to apply the results of research in artificial intelligence to the task in the future. This would allow the system to execute much more complex and dynamic decision logic than is possible with today's decision aids.

(U) During the course of this study, drafts of these charts were reviewed with Service users and developers, and contractor representatives for all of the systems; their suggested revisions and corrections have been incorporated.

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[1](U) PM FATDS, *System Specification for the Advanced Field Artillery Tactical Data System*, CR-CE-0089-001D, 18 September 1985, UNCLASSIFIED.

FUNCTIONAL TASK GROUPS

1. FIRE SUPPORT CONTROL AND COORDINATION

2. TUBE/AIR CONFLICT PROCESSING

3. TARGET GENERATION AND PROCESSING

4. AIR SUPPORT PROCESSING

5. FIELD ARTILLERY TACTICAL OPERATIONS

6. FIELD ARTILLERY SUPPORT AND SUSTAINMENT

7. FA TECHNICAL FIRE DIRECTION

8. SUPPORT OF OBSERVER OPERATIONS

9. FORWARD AREA AIR DEFENSE

10. EMBEDDED TRAINING

11. POSITION LOCATION INFORMATION PROCESSING

12. COMMON FUNCTIONS

A-3

(U) Task Group 1, FIRE SUPPORT CONTROL AND COORDINATION, provides the overall supervision of all fire support means in support of maneuver operations. The control and coordination tasks integrate naval gunfire, offensive air support, mortars, offensive electronic warfare, field artillery, and other available fire support means into the overall force's scheme of maneuver.

(U) MIFASS does not support most of the tasks in this group. MIFASS does provide support in conventional fire support planning, target/attack system analysis, and generation of orders to fire. Most of the support is provided interactively in accordance with Marine Corps doctrine, which requires step-by-step operator control of all fire support processes. The "A" in the "target/weapon system analysis" task reflects the fact that, although the target/weapon assignment is made by the operator, the system executes a volume-of-fire algorithm to determine if the selected unit has sufficient ammunition of the right kind to inflict the desired degree of damage on the target. The Marine Corps has indicated that decision aids will be added for fire support planning and fire plan execution as part of a post-IOC pre-planned product improvement (P3I) program.

(U) AFATDS tasks, on the other hand, have a high degree of automation considered necessary to deal with the projected threat to the Army forces. Decision aids are provided for many of the tasks. The CEP System, which will be tested only at brigade and below, will not provide support for the nuclear functions; however, these will be added by Version 2 IOC. Although the tasks can be performed in totally automated fashion, there are built-in intervention points that the operator can invoke for training purposes or for any other situation requiring close operator control. Decision aids are used heavily in determining the fire support planning guidance. A capability will be available for considering at least eight operations plans, each with two courses of action (COAs) and each COA with four options. A decision aid will rank order the COAs for the commander's decision and then optimize fire support employment for the selected COA. A decision aid will also assist in preparing some 230 items of planning guidance. As a part of the software maturation plan (software Versions 4 and 5), the FS planning guidance functionality will be enhanced by introducing sophisticated forecasting models, forecasting algorithms, and artificial intelligence capabilities for use along with data from other applications packages to "...properly assess the capability to support alternative courses of action, decide on attack alternatives and predict continuous combat supportability requirements on a real-time basis." The comparison of the support provided to various tasks over that provided by TACFIRE is of interest in demonstrating the greatly enhanced capabilities AFATDS will provide.

FUNCTIONAL AND AUTOMATION REQUIREMENTS FOR TACFIRE, MIFASS, AND AFATDS

Functional Task Groups	TACFIRE	MIFASS EDM	MIFASS IOC	AFATDS CEP	AFATDS IOC [V2]¹	AFATDS OBJ SYSTEM [V5]
1. FIRE SUPPORT CONTROL AND COORDINATION						
Determine Fire Support Planning Guidance						
Determine Attack and C2 System Requirements for OPLAN	M	M	M	DA	DA	DA
Determine Supportability of OPLAN	M	M	M	DA	DA	DA/E
Rank/Order Courses of Action (COAs)	-	-	-	DA	DA	DA
Optimize FS Employment for Selected COA	M	M	M	DA	DA	DA
Prepare FS Planning Guidance	M	M	M	DA	DA	DA/E
Perform Fire Support Planning (All FS Means)						
Prepare Overall FS Plan:						
Nuclear/Chemical Munitions	-	-	I/A²	-	A	A
Conventional	-	-	M	A	A	A
Allocation and Distribution of Attack Systems	M	M	-	DA	DA	DA
Target Damage Assessment (TDA) Analysis						
Process Invalid or Unsupportable TDA Requests	-	-	-	-	DA	DA
TDA Status Reporting	(	-	-	A	A	A
Perform Fallout Prediction Calculations	-	-	-	-	A	A
Perform Target/Attack System Analysis						
Nuclear/Chemical	LA³	-	A²	-	A	A
Conventional	LA³	A	-	A⁴	A	A
DA to Process Unsupportable Targets	-	-	-	DA	DA	DA
Perform Order to Fire and Mission Status Reporting						
Prepare and Send Fire Orders:						
Nuclear/Chemical	A	-	-	-	DA	DA
Conventional	A	A	A	DA	DA	DA
Perform FS Movement Coordination	M	M	M	A	A	A

LEGEND:
- = Not performed   A = Automated
- M = Manual   DA = Decision Aid
- I = Interactive   E = Expert System if Research Succeeds

1 Numbers refer to planned AFATDS software Versions V2 and V5.
2 Decision aids for Fire Support Planning and Fire Plan Execution will be added in a post-IOC P3I program.
3 Limited automation. Does not consider air or naval gunfire.
4 Does not consider effects of air weapons.

(U)   This chart snows the functional capabilities of the fire support systems for the next three task groups:

- Task Group 2, TUBE/AIR CONFLICT PROCESSING. Tube/Air Conflict Processing, per se, is performed only in MIFASS. It reflects the Marine Corps doctrine for guaranteeing that the trajectories of artillery and mortar shells do not intersect the flight paths of scheduled air missions (e.g., transport, search and rescue, close air support). This calculation is performed automatically each time an attempt is made to assign a target to a particular weapon. Conflicts are signalled to the Fire Direction Officer (FDO) by a flashing symbol on the display. The FDO may then hold the fire until the aircraft is safely out of the way, reroute the aircraft, or decide that the situation justifies the risk of firing the rounds. The Army, on the other hand, establishes safe corridors in space and time through which close air support (CAS) missions are routed. Conflicts would be automatically detected during review of whether the fire would violate these airspace coordination areas.

- Task Group 3, TARGET GENERATION AND PROCESSING. MIFASS support of this functional capability is confined largely to developing and maintaining a target list. Partial lists for the lower echelons are automatically combined into a consolidated landing force target list. In AFATDS, additional tasks are performed and more automation is provided in order to deal with the magnitude of the threat. Of particular interest are analysis of target value and assignment of target priority. In the CEP and IOC systems, a decision aid is provided that assigns target value and priority based on commander's guidance and a formula taking into account, among other variables, target characteristics, dwell time, and time since detection. A separate Independent Research and Development (IR&D) project is underway to develop an expert system to perform target value analysis and prioritization. If this research succeeds, such an augmented capability will be implemented during the P3I Program. Again, the comparison of AFATDS with TACFIRE illustrates the greatly enhanced capability AFATDS will provide.

- Task Group 4, AIR SUPPORT PROCESSING. Direct air support is an important task group that is unique to the Marine Corps as a fire support task. It supports air mission planning and execution in the same manner that other planning and execution functions support the ground weapons. In the current operations concept, these tasks are performed at the DASC, the principal control agency for conduct of direct air support operations. The DASC provides means for processing direct air support requests, assigning direct air support resources, coordinating employment with other supporting arms, monitoring missions, and exercising procedural control over direct air support aircraft. All of these tasks are performed interactively in accordance with Marine Corps doctrine.

FUNCTIONAL AND AUTOMATION REQUIREMENTS FOR TACFIRE, MIFASS, AND AFATDS (CONT'D)

Functional Task Groups	TACFIRE	MIFASS ĒDM	MIFASS IOC	AFATDS CEP	AFATDS IOC [V2][1]	AFATDS OBJ SYSTEM [V5]
2. TUBE/AIR CONFLICT PROCESSING	-	A	A	-	-	-
3. TARGET GENERATION AND PROCESSING						
Determine TA Support Capability						
Identify Area of Required Support	M	M	M	A	A	A
Determine Concept of TA Employment	M	M	M	-	A	A
Perform Target Processing						
Perform Target Value Analysis & Prioritization	M	M	M	DA	DA	DA/E
Develop and Maintain Target List (File)	A	I/A	I/A	A	A	A
Develop Sensor Guidance/Tasking	-	-	-	I[3]	A	A
Evaluate TDA Report from IEW	M	M	M	-	I	I
4. AIR SUPPORT PROCESSING						
Perform Air Support Processing[2]	· · · · ·	— — — — —	— — — — —	· · · · ·	· · · · ·	· · · · ·
Generate Coordinated Air Plans[2]						
Perform Helicopter Control[2]						
Provide Aircraft Direction[2]						
Flight Path Profiling[2]						

LEGEND:
- · = Not performed
- M = Manual
- I = Interactive
- A = Automated
- DA = Decision Aid
- E = Expert System if Research Succeeds

[1] Numbers refer to planned AFATDS software Versions V2 and V5.
[2] Performed in DASC under current operations concept.
[3] Artillery reports only.

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A-7

(U) Tasks and subtasks in Task Group 5. FIELD ARTILLERY (FA) TACTICAL OPERATIONS, support the management of FA delivery units and sensors. Included in this operational category are preparation of plans, maintenance of status, coordination of movement, support of meteorological and survey operations, and preparation of fire orders. It also includes FA unit planning that transforms guidance into specific instructions and details of how requirements are to be met. Unit plans may include such specific items as unit locations and firing schedules.

(U) Many of the tasks in this group are similar to tasks in the Fire Support Control and Coordination group, except that in this group they are concerned with artillery (and mortars) rather than with all fire support means. For these similar tasks the capabilities of the three systems are also similar. Many of these tasks are performed manually by the Marine Corps and are not supported by MIFASS. For tasks that are supported by MIFASS, the support is mostly at the interactive level. However, there is a Marine Corps plan to add decision aids for FA fire planning and fire plan execution as part of a post-IOC P3I effort. The similar tasks in AFATDS are largely automated or supported by decision aids. Refinements, but no major enhancements, are expected in the Army post-IOC P3I program.

(U) For the other tasks in this group, including meteorological and survey operations, FA movement control, and FA sensor operations, the pattern of automation is the same. The AFATDS operation employs high levels of automation and provides greatly improved capabilities over TACFIRE. MIFASS, in accordance with the Marine Corps doctrine and procedures, supports a few tasks automatically, and some interactively; it provides no support at all for a number of other tasks. Although MIFASS does support survey calculations, they are performed in a separate Fire Direction/Survey Calculator, which is not planned for fielding with the initial system.

FUNCTIONAL AND AUTOMATION REQUIREMENTS FOR TACFIRE, MIFASS, AND AFATDS (CONT'D)

Functional Task Groups	TACFIRE	MIFASS EDM	MIFASS IOC	AFATDS CEP	AFATDS IOC [V2][1]	AFATDS OBJ SYSTEM [V5]
5. FIELD ARTILLERY (FA) TACTICAL OPERATIONS						
Determine FA Concept of Operations						
Prepare FA Support Planning Guidance	M	M	M	DA	DA	DA
Select Recommended FA Course of Action	M	M	M	DA	DA	DA
Perform FA Planning Support (Force Level)						
Create FA Fire Plan:						
Nuclear/Chemical	I/A	-	I/A[2]	-	A	A
Conventional	I/A	I/A	M	A	A	A
Create FA Attack, Sensor, and C2 System Directives	M	M	A	DA	DA	DA
Field Artillery Status Reporting	A	A	A	A	A	A
Prepare Fire Order						
Determine Units Capable of Attack	A	-	A[2]	A	A	A
Select Attack Units	DA	A	-	DA	DA	DA
Send Fire Orders	I/A	-	-	A	A	A
Meteorological Operations						
Create Meteorological Support Plan	-	-	-	-	A	A
Maintain Meteorological Data File	A	A	A	A	A	A
Survey Operations						
Create Survey Support Plan	-	-	-	-	A	A
Perform Survey Calculations	A	I[3]	I[3]	A	A	A
Maintain Survey File	A	A	A	A	A	A
FA Movement Coordination and Control						
Develop Movement Requirement	M	M	M	A	A	A
Prepare Movement Orders	M	M	M	A	A	A
Create Movement Reports	M	M	M	A	A	A
Conduct FA Sensor Operations	M	-	-	-	A	A
Perform FA Unit Planning	A	A	A	A	A	A

LEGEND: - = Not performed   A = Automated
            M = Manual   DA = Decision Aid
            I = Interactive   E = Expert System if Research Succeeds

1 Numbers refer to planned AFATDS software Versions V2 and V5.

2 Decision aids for Field Artillery Fire Planning and Fire Plan Execution will be added as part of P3I program.

3 Performed by the Fire Direction/Survey Computer (FS/SC), not planned for initial implementation.

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A-9

(U)   This chart shows the functional capabilities of the three systems for three additional fire support task groups:

- Task Group 6, FA SUPPORT AND SUSTAINMENT. This task group includes the functions necessary to logistically and administratively support the FA systems. It also involves creating movement tables, resolving conflicts, and determining the effects of route changes in support of the movement control tasks in other task groups. As can be seen, MIFASS does not support movement processing; this task is performed manually by the Marine Corps. AFATDS will have some interactive capability in the CEP test, and the task will be fully automated by IOC. Again, AFATDS shows a marked improvement over TACFIRE. Also, as indicated, both MIFASS and AFATDS will support ammunition control. AFATDS will have an interactive capability in the CEP, primarily because automatic reports will not yet be available from the BCS System. AFATDS will have a fully automatic capability for this at IOC.

- Task Group 7, TECHNICAL FIRE DIRECTION, and Task Group 8, SUPPORT OF OBSERVER OPERATIONS. Technical Fire Direction includes the functions that are necessary to generate firing data for cannon (or mortar) delivery systems and to process and maintain current status of fire missions. Support of Observer Operations includes those subtasks necessary to integrate the forward observer into the process of carrying out observed fire missions. Some of the more important subtasks are shown on the chart. Although the chart shows that these two tasks have both interactive and automated components, a detailed examination of how each system processes an observed fire mission reveals the usual doctrinal and procedural differences in the degree of automation employed and the degree of manual control involved. In MIFASS, every step in the process is controlled interactively until the final end-of-mission report has been prepared. AFATDS, on the other hand, is capable of processing the fire mission automatically, interrupted only by firing from the units and observer's reporting of results. In fact, in the AFATDS mission threads,[1] there are no intervention points in the process beyond the first adjustment from the forward observer.

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[1](U) Magnavox, *Detailed Mission Thread Data Flow;* undated, but some illustrations are dated December 1985, UNCLASSIFIED. Provided to IDA Study Team on 22 September 1986.

FUNCTIONAL AND AUTOMATION REQUIREMENTS FOR TACFIRE, MIFASS, AND AFATDS (CONT'D)

Functional Task Groups	TACFIRE	MIFASS EDM	MIFASS IOC	AFATDS CEP	AFATDS IOC [V2][1]	AFATDS OBJ SYSTEM [V5]
6. FIELD ARTILLERY SUPPORT & SUSTAINMENT						
FA Movement Processing						
Create Movement Tables	M	M	M	-	A	A
Resolve Conflicts	M	M	M	-	A	A
Determine Effects of Route Info Changes	M	M	M	-	A	A
EA Supply Control (Ammunition Only)	-	-	-	-	A	A
7. TECHNICAL FIRE DIRECTION[2]						
Maintain Fire Unit Capability Files	A	I/A	I/A	I/A	A	A
Process & Control Fire Unit Missions	-	A	A	A	I/A	I/A
Compute Ballistic Solutions	A	A	A	A	A	A
Prepare Fire Commands	A	A	A	A	A	A
Create End of Mission Sequence	-	-	-	-	-	-
Create Registration List	?	-	-	A	A	A
Fire Mission Status Reporting	A	A	A	A	A	A
8. SUPPORT OF OBSERVER OPERATIONS						
Transmit Fire Missions	I/A	I/A	I/A	I/A	I/A	I/A
Receive Reports	I/A	I/A	I/A	I/A	I/A	I/A
Make Subsequent Adjustments	I/A	I/A	I/A	I/A	I/A	I/A

LEGEND: - = Not performed   A = Automated
           M = Manual   DA = Decision Aid
           I = Interactive   E = Expert System if Research Succeeds

1 Numbers refer to planned AFATDS software Versions V2 and V5.
2 Also performed by BCS.

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LS-19-33

UNCLASSIFIED

(U) This chart shows the functional capabilities of the three fire support systems in the remaining four fire support task groups:

• Task Group 9, FORWARD AREA AIR DEFENSE (FAAD). This task is performed only in MIFASS. Marine Corps doctrine and procedures include coordination and integration of FAAD systems as part of all combined arms fire support means. The responsibility for performing this coordination and integration is assigned to the fire support C2IEs, hence to MIFASS. In performing this task, MIFASS will provide message links to FAAD personnel and will disseminate situation and status reports as needed by all the fire support C2IEs. As indicated, this process will be performed interactively.

• Task Group 10, EMBEDDED TRAINING. Although both Services eventually require embedded training, only AFATDS will have this capability by IOC. This capability will make it possible to "train and evaluate the proficiency of all users at all levels of individual or collective skills." Scenarios will be developed to provide operator/workstation training and performance evaluation, crew-level and system-level (force) situational simulation exercises and operational efficiency evaluation, and training base requirements. Although MIFASS will not have embedded training by IOC, there is a plan to add simulation and training software with automatic scenario generation in a post-IOC P3I program.

• Task Group 11, POSITION LOCATION INFORMATION PROCESSING. This is also a MIFASS-only task. The Marine Corps will establish a link between the PLRS Master Station and the MIFASS equipment at the senior Maneuver CP in order to greatly improve the knowledge of the locations of all the fire support and related elements including the C2IEs, the fire delivery units (airborne and ground units), the various observers, and the sensor system. This position information will be processed and disseminated throughout the fire support structure as needed. As indicated, this is one of the few fully automated processes in MIFASS. The Army fire support OPFACs have the same need for this information, but will receive it through an interface with the Maneuver Control System (MCS), one of the other ACCS systems, which will be fed from the Army Enhanced PLRS.

• Task Group 12, COMMON FUNCTIONS. The common functions shown on the chart are relatively straightforward. Although not shown in the level of detail provided on this chart, these processes have the same differences in degree of automation that is appropriate to the doctrine and procedures of the respective Services.

A-12

UNCLASSIFIED

FUNCTIONAL AND AUTOMATION REQUIREMENTS FOR TACFIRE, MIFASS, AND AFATDS (CONT'D)

Functional Task Groups	TACFIRE	MIFASS EDM	MIFASS IOC	AFATDS CEP	AFATDS IOC [V2][1]	AFATDS OBJ SYSTEM [V5]
9. FORWARD AREA AIR DEFENSE	-	-	-	-	-	-
10. EMBEDDED TRAINING	-	-	-[2]	-	I/A	I/A
11. POSITION LOCATION INFORMATION PROCESSING	-	A	A	-	-	-
12. COMMON FUNCTIONS						
Perform Message Handling/Processing	A	A	A	A	A	A
Data Base Display	I/A	I/A	I/A	I/A	I/A	I/A
Status Reporting	A	A	A	A	A	A

LEGEND: - = Not performed   A = Automated
      M = Manual   DA = Decision Aid
      I = Interactive   E = Expert System if Research Succeeds

[1] Numbers refer to planned AFATDS software Versions V2 and V5.
[2] Simulation and training software with automatic scenario generation will be added as part of P3I program.

A-13

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A-14

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APPENDIX B

DETAILED INFORMATION: ARMY FIELDS MIFASS (OPTION 1)

NOTE: The information in this Appendix was reviewed by the Services on 12-13 November 1986.

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(U)   Option 1 addresses issues associated with the Army fielding MIFASS. The issues identified in the first part of Table 1.0 establish the degree to which MIFASS, as developed for the MIFASS IOC, will meet the Army requirements (the numbers in parentheses refer to tables). The other issues are compatibility with other Army systems and schedule/cost considerations. At the end of this Appendix (Table 1M.1) is a discussion of the changes required in MIFASS to meet the Army needs.

(U)   Army requirements are examined in four separate areas: functions (Table 1.1); interfaces (Table 1.2); physical characteristics (Table 1.3); and organization, doctrine, and procedures (Table 1.4). Since the MIFASS environmental requirements (compare Table 3B.5b) are MILSPEC and exceed AFATDS requirements, the central physical characteristics issue is weight. The methodology used by IDA in developing weight (and cost) estimates for Option 1 is explained in the discussion for Table 1.4.

(U)   A key issue for Option 1 is assessing what Army units should be included in a MIFASS fielding. Since TACFIRE is now fielded to the heavy divisions in the active force, another issue (Table 1.5) is the advantages and disadvantages of using MIFASS as a replacement for TACFIRE. Since TACFIRE was not fielded to the light divisions, an additional issue is whether MIFASS can satisfy the Army light division requirements (Table 1.6a). A separate chart (Table 1.6b) compares MIFASS and TACFIRE weights for an Army light division.

(U)   The Army Command and Control System (ACCS) is an umbrella system of systems that supports command and control in five battlefield functional areas: fire support, air defense, intelligence/electronic warfare, maneuver control, and combat service support. ACCS also includes force level control. Table 1.7 addresses the degree to which MIFASS is compatible with the ACCS common hardware/software concept being used by the Army to develop these systems.

(U)   Table 1.8 addresses schedule, and Table 1.9 addresses the cost of fielding MIFASS to the Army's total force.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.0 MAJOR ISSUES ADDRESSED

- **HOW WELL DOES MIFASS MEET ARMY REQUIREMENTS FOR AN ADVANCED FIRE SUPPORT SYSTEM?**

  - REQUIREMENTS
    - -- Functions (1.1)
    - -- Interfaces (1.2)
    - -- Physical Characteristics (1.3)
    - -- Organization, Doctrine, and Procedures (1.4)
  - IN WHAT UNITS MIGHT THE ARMY FIELD MIFASS?
    - -- Heavy Divisions -- Replace TACFIRE? (1.5)
    - -- Light Divisions -- Meet Light Division Requirements (1.6)

- **IS MIFASS COMPATIBLE WITH ACCS COMMON HARDWARE/ SOFTWARE CONCEPT? (1.7)**

- **WHEN COULD MIFASS BE PROVIDED TO ARMY? (1.8)**

- **HOW MUCH WOULD IT COST TO FIELD MIFASS TO THE ARMY? (1.9)**

B-3

(U) Table 1.1 contrasts the Army fire support (FS) functional requirements with MIFASS capabilities at IOC.[1] The table shows that MIFASS does not support a number of Army required functions, including those associated with nuclear and chemical operations. Further, in order to meet its high intensity threat, the Army requires a greater degree of automation than is provided by MIFASS. Specific shortcomings are as follows:

- In FS Control and Coordination, there is a requirement for determining planning guidance, including analysis of supportability of the operations plan (OPLAN) and rank ordering various courses of action. There is also a requirement for FS planning attack system analysis for nuclear and chemical weapons (artillery, missiles, and air) and for Army-only weapons such as heavy mortars, Multiple Rocket Launcher System (MLRS), and Army Tactical Missile System (ATACMS). Fallout prediction must be done for both friendly and enemy detonations. MIFASS does not support these functions.

- In Target Generation and Processing, MIFASS does not meet the Army requirements to determine target acquisition (TA) support capability and to perform target value analysis and prioritization.

- In FA Tactical Operations, MIFASS does not support determination of a field artillery operations concept nor the FS planning and attack system analysis for nuclear and chemical weapons. Survey calculations are supported in MIFASS only by a separate computer, and movement control and coordination is supported only by processing of Position Location Reporting System (PLRS) inputs. No support is provided for conducting FA sensor operations.

- In FA Support and Sustainment, MIFASS supports ammunition control but does not provide movement tables, conflict resolution, and impact-of-route-change processing needed for movement control.

- Embedded training will not be available in MIFASS until after IOC.

(U) In addition to the specific functional deficiencies listed above, a major shortcoming of MIFASS is that it does not provide the degree of automation of the fire support processes considered necessary to meet the threat presentation rates predicted by the Army in future conflicts. For example, at the Maneuver Brigade FSE, the Army expects to store and deal with 4,390 targets in a 24-hour period, in contrast to 360 targets per day expected at the corresponding Marine Corps headquarters. This requires the availability of highly automatic operation with little or no intervention by the operators. MIFASS, on the other hand, is designed for hands-on control of every step in the fire support processes.

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[1](U) A more detailed breakdown of the functional tasks and the degree to which each system supports them can be found in Appendix A.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.1 SOME MAJOR ARMY FIRE SUPPORT FUNCTIONAL REQUIREMENTS vs MIFASS CAPABILITIES[1]

FUNCTIONS	REQUIRED BY ARMY	MIFASS IOC
FS CONTROL & COORDINATION		
Determine Planning Guidance	YES	NO
Perform FS Planning	CONV/NUC/CHEM	CONV ONLY
Attack System Analysis	CONV/NUC/CHEM	CONV ONLY
TARGET GENERATION PROCESSING		
Determine TA Support Capability	YES	NO
Target Processing	YES	PARTIAL[2]
FA TACTICAL OPERATIONS		
Determine FA Ops Concept	YES	NO
Fire Support Planning	CONV/NUC/CHEM	CONV ONLY
FA Attack System Analysis	CONV/NUC/CHEM	CONV ONLY
Support Met and Survey	YES	PARTIAL[3]
Movement Control/Coordination	YES	PARTIAL[4]
Conduct FA Sensor Operations	YES	NO
Status Reporting	YES	YES
FA SUPPORT AND SUSTAINMENT	YES	PARTIAL[5]
TECHNICAL FIRE DIRECTION	YES	YES
SUPPORT OF OBSERVER OPERATIONS	YES	YES
EMBEDDED TRAINING	YES	NO[6]

1. To meet its high intensity threat, Army requires greater degree of automation than MIFASS provides.
2. MIFASS maintains target list but has no Target Value Analysis & Prioritization.
3. Survey calculations per.ormed in separate Fire Direction/Survey Computer, not currently planned to be initially fielded in MIFASS
4. MIFASS performs Position Location Information Processing from PLRS inputs; rest is manual.
5. MIFASS performs Ammo Control, but not Movement Control.
6. Planned for development after IOC.

CONCLUSION: MIFASS DOES NOT SUPPORT A NUMBER OF ARMY REQUIRED FUNCTIONS, INCLUDING THOSE ASSOCIATED WITH NUCLEAR AND CHEMICAL OPERATIONS. IN ORDER TO MEET ITS HIGH INTENSITY THREAT, THE ARMY REQUIRES A GREATER DEGREE OF AUTOMATION THAN THAT PROVIDED BY MIFASS.

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(U)   Table 1.2 identifies the interfaces required by the Army for an advanced fire support system. Each of the interfaces listed in the first column of the chart is specified in the AFATDS system specification,[1] except the Guardrail Commanders' Tactical Terminal (CTT).[2] The North Atlantic Treaty Organization (NATO) interfaces specified are ADLER (Federal Republic of Germany) and BATES (United Kingdom). The Joint Interoperability Tactical Command and Control System (JINTACCS) interface includes MIFASS.

(U)   Several of the required interfaces use the TACFIRE protocol and subsets of the TACFIRE message set. Of these, Battery Computer System (BCS), Firefinder TPQ-36/37, and Meteorological Data System (MDS) are to be supported by MIFASS by IOC. Eight others are not: Airborne Target Handoff System (ATHS), Digital Message Device (DMD), Fire Support Team (FIST) DMD, Lance, Mortar Ballistics Computer (MBC), Multiple Launch Rocket System (MLRS), Remotely Piloted Vehicle (RPV), and Joint Surveillance Target Acquisition Radar System (JSTARS). MIFASS would include an interface to TACFIRE at IOC if AFATDS were not to be available by that time; specifications for a TACFIRE interface beyond BCS, Firefinder, and MDS have not yet been developed.

(U)   MIFASS will provide the interface to the Digital Communications Terminal (DCT), assuming that the Army uses Marine Corps software for DCT protocols and messages. The protocols and messages for the Army Tactical Missile System have not yet been determined. The remaining four interfaces would not be provided by MIFASS: ACCS/Force Level Control, Elevated Target Acquisition System, Guardrail CTT, and ADLER/BATES.

[1](U) PM FATDS, System Specification for the Advanced Field Artillery Tactical Data System, CR-CE-0089-001D, 18 September 1985, UNCLASSIFIED.

[2](U) Included in an unreleased revision to the AFATDS Systems Specification, excerpt provided to IDA by PM FATDS, November 1986, UNCLASSIFIED.

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OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.2 INTERFACES - AFATDS REQUIREMENTS vs MIFASS CAPABILITIES

AFATDS INTERFACES - SW VERSION 2	MIFASS IOC
ACCS AND FORCE LEVEL CONTROL SYSTEMS	NO
AIRBORNE TARGET HANDOFF SYSTEM (ATHS)	NO[1]
BATTERY COMPUTER SYSTEM (BCS)	YES[1]
DIGITAL COMMUNICATIONS TERMINAL (DCT)	YES[2]
DIGITAL MESSAGE DEVICE (DMD)	NO[1]
ELEVATED TARGET ACQUISITION SYSTEM (ETAS)	NO
FIREFINDER	YES[1]
FIRE SUPPORT TEAM DMD	NO[1]
GUARDRAIL COMMANDERS' TACTICAL TERMINAL (CTT)	NO
HOWITZER IMPROVEMENT PROGRAM (HIP)	YES
LANCE	NO[1]
MORTAR BALLISTICS COMPUTER (MBC)	NO[1]
METEOROLOGICAL DATA SYSTEM (MDS)	YES[1]
MULTIPLE LAUNCH ROCKET SYSTEM (MLRS)	NO[1]
REMOTELY PILOTED VEHICLE (RPV)	NO[1]
TACFIRE	NO[3]
JINTACCS	YES
NATO ALLIES	NO
JOINT SURV TGT ACQ RADAR SYS (JSTARS)	NO[1]
ARMY TACTICAL MISSILE SYSTEM (ATACMS)	TBD

[1] USES TACFIRE PROTOCOL AND A SUBSET OF TACFIRE MESSAGE SET.
[2] ASSUMES MARINE CORPS SOFTWARE WOULD BE USED FOR PROTOCOLS AND MESSAGES.
[3] WOULD BE INCLUDED IN MIFASS AT IOC IF AFATDS NOT AVAILABLE.

TBD = TO BE DETERMINED

CONCLUSION: MIFASS DOES NOT HAVE SEVERAL MAJOR ARMY REQUIRED INTERFACES

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(U) Table 1.3a shows how much the MIFASS hardware would weigh when fielded to the Army. The chart shows a range of estimates for the AFATDS baseline weight, in which the variation is due to uncertainty about what equipment will be selected and which requirements will drive this decision (see Tables 3A.5a and 3A.6c). Assumptions used in configuring MIFASS for Army centers are given below. The key assumption is that the number of workstations will be the same as required for AFATDS, based on the Fire Support Automation Plan.[1] The chart also shows sensitivity to another assumption, namely, whether the Army will use one string of equipment (as in AFATDS; or two strings (to support echeloning for continuity of operations as in MIFASS).

(U) As examples, the chart shows weight estimates for selected maneuver fire support elements (FSEs) and artillery command posts (CPs). The numbers for division and subordinate echelons are associated with a heavy division. Equipment at the battery element could be at the battery command post or allocated to its supporting platoons. The values for the total force are based on fielding to active, reserve, and national guard units for heavy divisions, light divisions, field artillery brigades, corps assets, and other force structure elements. PM FATDS estimates the force as roughly 65 division equivalents, based on 5 corps, 6 light divisions, 23 heavy divisions, 30 field artillery brigades, and one training base. A division equivalent in this chart and elsewhere in the IDA assessment is defined as 1/65th of the total force.

(U) The low factor, shown for each center and choice of number of MIFASS strings in the configuration, is the ratio of the MIFASS weight to the high AFATDS weight estimate, and the high factor is the ratio of the MIFASS weight to the low AFATDS weight estimate. Equipment at the direct support battalion (DS Bn) FDC would weigh 1,300 lb for one string and 2,190 lb for two strings using MIFASS. This is 1.9-4.1 and 3.2-6.8 times, respectively, as heavy as the 320-680 lb for AFATDS equipment. Averaged over the whole force, equipment at Army centers is 1.8-4.0 times as heavy as AFATDS using a single string of MIFASS and 2.4-5.2 times as heavy using two strings of MIFASS.

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[1](U) PM FATDS, *Fire Support Automation Plan*, 22 August 1986, UNCLASSIFIED.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.3a HOW MUCH WILL MIFASS HARDWARE WEIGH FOR ARMY?

	AFATDS BASELINE WEIGHT (lbs)	USING MIFASS-ONE STRING		USING MIFASS-TWO STRINGS	
		WEIGHT (lbs)	FACTOR	WEIGHT (lbs)	FACTOR
TOTAL FORCE	400,000-869,000,000	1,592,000	1.8-4.0	2,082,000	2.4-5.2
DIVISION EQUIV	6,150-13,400	24,500	1.8-4.0	32,030	2.4-5.2
FSEs (HVY DIV)					
CORPS TAC	290-680	1,150	1.7-4.0	2,030	3.0-7.0
CORPS MAIN	370-800	1,340	1.7-3.6	2,190	2.7-5.9
DIV TAC	290-680	1,150	1.7-4.0	2,030	3.0-7.0
DIV MAIN	370-800	1,340	1.7-3.6	2,190	2.7-5.9
Bde FSE	400-800	1,520	1.9-3.8	2,680	3.4-6.7
Bn FSE	170-360	680	1.9-4.0	680[a]	1.9-4.0
ARTY CPs (HVY DIV)					
CORPS ARTY	1,010-2,210	3,060	1.4-3.0	4,110	1.9-4.1
DIV ARTY	460-1,040	1,490	1.4-3.2	2,680	2.6-5.8
FA Bde HQ	570-1,270	1,790	1.4-3.1	3,030	2.4-5.3
DS Bn FDC	320-680	1,300	1.9-4.1	2,190	3.2-6.8
BATTERY/PLATOON	110-240	550	2.3-5.0	550[a]	2.3-5.0

[a]Only one string used at lowest echelon.

CONCLUSION: ON THE BASIS OF A COMPARABLE NUMBER OF WORKSTATIONS, MIFASS WOULD WEIGH BETWEEN 2 AND 5 TIMES AS MUCH AS AFATDS. RANGE DUE TO UN-CERTAINTY IN WEIGHTS OF COMPONENTS FOR AFATDS AND DEGREE TO WHICH ARMY WOULD EMPLOY ECHELONING TECHNIQUE OF MARINE CORPS THAT REQUIRES 2 MIFASS STRINGS.

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(U)   Table 1.3b identifies the assumptions used by IDA in developing MIFASS configurations for the Army.   The configurations all presume a comparable number of MIFASS workstations will be provided as required for AFATDS. The basis for the center equipment is the Fire Support Automation Plan and Army force structure data.[1]

(U)   The direct support Bn FDC is representative of most center configurations.   With AFATDS, it has one FSCT, two FSTs, one PLU, one Electronic Printer (EP), one Power Converter Group (PCG), one Medium-Screen Display (MSD), and a cable set with LAN. A single string of MIFASS in this analysis has three DSDs, three CCPs, no T1Ps, one T2P, one MC, one MM, one Mass Storage Device (MSD), one PM, four BBs, one DCE, one Star Coupler (SC), and a cable set.   For the two-string case, Bn FDC has the same number of DSDs, CCPs, and MSDs; two each of T1Ps,T2Ps, MCs, MMs, PMs, and DCEs; eight BBs; four SCs; and two cable sets.

(U)   In every center configured with MIFASS, one DSD is provided for each FSCT and FST required for AFATDS.   The same number of CCPs as DSDs is used.   One Mass Storage Device is provided for each center.   The one-string case was developed to use the smallest number of components that provide the same number of workstations and printers as required for AFATDS: one T2P for each EP; one MC and one MM for each pair of DSDs, rounded down (e.g., 2 MMs and 2 MCs for 5 DSDs); one each of PM, DCE, SC, and cable set for each center (except 2 SCs to support the large number of components at Corps Arty CP); and four BBs for each center (except 8 BBs for the large number of components at Corps Arty).   The two-string case was developed using fully populated double-strings, similar to those used by the Marine Corps with the same number of workstations as in the one-string configurations. The two-string configurations have at least two T1Ps, T2Ps, MCs, and MMs, with one MC and one MM for each pair of DSDs, rounded down; two each of PMs, DCEs, and cable sets; 4 SCs; and eight BBs at each center (except 14 at centers with 4-6 DSDs and 20 at centers with more than 6 DSDs).

(U)   For AFATDS, configurations for Bn FSE and battery/platoon are exceptional in that they do not have a full set of AFATDS components: one or two FSTs, one PLU, and one EP (no FSCT, PCG, or LAN). In this analysis, the MIFASS configurations at these lowest echelons were the same for both one- and two-string cases: one DSD (two for Bn FSE-Heavy Division), one each of T1Ps, MCs, MMs, MSDs, PMs, DCEs, and SCs; and one half of a cable set.

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[1](U) PM FATDS, *Information Provided to IDA in Support of the 7 October 1986 Briefing to OSD,* 17 October 1986, UNCLASSIFIED.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.3b ASSUMPTIONS FOR CONFIGURATIONS USED IN COST AND WEIGHT ESTIMATES

- **EXAMPLE - DS FA BATTALION FDC FOR HEAVY DIVISIONS**

  - AFATDS: 1 FSCT, 2 FSTs, 1 PLU, 1 EP, 1 PCG, 1 MSD, 1 CABLE SET WITH LAN

  - MIFASS

    -- SINGLE-STRING CASE FOR LOWER BOUND: 3 DSDs, 3 CCPs, 0 T1Ps, 1 T2P, 1 MC, 1 MM, 1 MSD, 1 PM, 4 BBs, 1 DCE, 1 SC, 1 CABLE SET

    -- TWO-STRING CASE FOR UPPER BOUND: 3 DSDs, 3 CCPs, 2 T1Ps, 2 T2Ps, 2 MCs, 2 MMs, 1 MSD, 2 PMs, 8 BBs, 2 DCEs, 4 SCs, 2 CABLE SETS

- **COMMON ASSUMPTIONS FOR ALL CENTERS**

  - ONE DSD FOR EACH FSCT AND FST; SAME NUMBER OF CCPs AS DSDs
  - ONE MASS STORAGE DEVICE (MSD) PER CENTER

- **LOWER BOUND ESTIMATED USING SINGLE-STRING OF MIFASS EQUIPMENT, ASSUMING SMALLEST NUMBER OF COMPONENTS TO PROVIDE SAME NUMBER OF WORKSTATIONS AND PRINTERS**

  - ONE T2P FOR EACH EP
  - ONE MC AND 1 MM FOR EACH PAIR OF DSDs (ROUND DOWN--2 MMs, MCs FOR 5 DSDs)
  - ONE PM, 1 DCE, 1 SC, AND 1 CABLE SET FOR EACH CENTER (EXCEPTION 2 SCs FOR CORPS ARTY)
  - FOUR BBs EACH CENTER, EXCEPT 8 AT CORPS ARTY

- **UPPER BOUND ESTIMATED USING FULLY POPULATED DOUBLE-STRING, SIMILAR TO CONFIGURATION USED BY MARINE CORPS**

  - TWO T1Ps AND 2 T2Ps EACH CENTER; 3 ADDITIONAL T2Ps AT CORPS ARTY TO EQUAL EPs FOR AFATDS
  - AT LEAST 2 MCs AND 2 MMs AT EACH CENTER; 1 MC AND 1 MM FOR EACH PAIR OF DSDs (ROUND DOWN)
  - TWO PMs, 2 DCEs, 4 SCs, AND 2 CABLE SETS AT EACH CENTER
  - EIGHT BBs AT EACH CENTER, EXCEPT 14 AT CENTERS WITH 4-6 DSDs AND 20 AT CENTERS WITH MORE THAN 6 DSDs

- **CONFIGURATIONS FOR BATTALION FSE AND BATTERY CP ARE EXCEPTIONAL AND ARE SAME FOR UPPER AND LOWER BOUND**

  - FOR AFATDS, THESE CENTERS HAVE 1 OR 2 FSTs, 1 PLU, AND 1 EP
  - USING MIFASS: 1 DSD, 1 T1P, 1 MC, 1 MM, 1 MSD, 1 PM, 1 DCE, 1 SC, AND 1/2 CABLE SET
  - FOR MIFASS, ADD 1 DSD WHEN CENTER (BN FSE-HVY) HAS 2 FSTs

B-11

BW (11-3) 2

(U) Table 1.4 shows that MIFASS software would need to be modified to satisfy Army organization, doctrine, and procedures. Some of these modifications may be significant. Aspects of Marine Corps organization, doctrine, and procedures have been integrated directly into the design of MIFASS. The EDM System was designed under a new organizational concept with a new staff element--an integrated Fire and Air Support Center (FASC)--replacing, but having different responsibilities from, the FSCC at each maneuver command post (CP). The new concept was so embedded in the design that a later decision to implement MIFASS according to the current organization required using a number of workarounds and tolerating operational anomalies. About $1.8 million is allocated in the MIFASS program to change back to the current Marine Corps organization for IOC. Implementing MIFASS in the Army would require more workarounds and create more anomalies.

(U) MIFASS is designed to support the Marine Corps' concept of echeloning, in which half of any OPFAC can be split off and moved to a new location while the stay-behind half performs the OPFAC function. At the new location, the relocated half of the OPFAC would take control while the stay-behind half moves to rejoin. This requires two duplicate sets of equipment. On the other hand, the Army has a forward element at each major echelon called the TAC CP. The TAC has less equipment than the Main CP and is involved more in the conduct of current operations, while the Main CP plans for the next day's operations. In addition, the Marine Corps has no equivalent of the Corps or Armored Cavalry Regiment; hence MIFASS has no hardware/software configuration to support special requirements for these echelons.

(U) A major procedural difference is the MIFASS operator-machine interface, in which each operator has a pictorial representation of the weapon/target situation supported by selected text records. Using a medium-screen display with touch panel and keyboard inputs, the operator maintains strong manual control over each step in the [unclear] process. This contrasts sharply with the Army interface that uses a small screen and processes that run automatically with as little intervention as possible. A higher degree of automation than MIFASS provides would be necessary in order to meet the high level of presentation rate of the Army threat. One other difference is that MIFASS has a built-in set of message formats, message distribution tables, display screens, and report formats tailored specifically to Marine Corps missions. Many of these would not be satisfactory for Army operations.

B-12

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.4 SOME ORGANIZATIONAL ASPECTS, DOCTRINE, AND PROCEDURES IMPACTING THE ABILITY OF MIFASS TO MEET ARMY REQUIREMENTS

- **ORGANIZATION AND DOCTRINE**

  - SERVICE OPFAC NAMES ARE DIFFERENT AND EMBEDDED IN SOFTWARE

  - USMC USES TWO SETS OF EQUIPMENT FOR ECHELONING. ARMY USES BASIC SET FOR MAIN CP WITH AUSTERE VERSION FOR TAC

  - MIFASS HAS NO SOFTWARE FOR ARMY ARMORED CAVALRY REGTs OR CORPS ECHELON

- **PROCEDURES**

  - MIFASS PROCEDURES UTILIZE PICTORIAL REPRESENTATION OF THE BATTLE-FIELD AND MULTIPLE OPERATOR ACTIONS FOR DESIGNATING WEAPON/TARGET PAIRS FOR POSITIVE CONTROL OF EACH STEP IN FIRE CONTROL PROCESS. ARMY REQUIRES AUTOMATION OF FIRE SUPPORT PROCESSES WITH MINIMAL MANUAL INTERVENTION TO MEET PROJECTED THREAT

  - EACH SYSTEM HAS TAILORED SET OF MESSAGES, DISPLAY SCREENS, AND RE-PORTS, MANY OF WHICH WOULD NOT BE SATISFACTORY FOR THE OTHER SERVICE

  - EACH SERVICE DISTRIBUTES MESSAGES DIFFERENTLY BASED ON ITS ORGANI-ZATION AND SOPs

CONCLUSION: MIFASS SOFTWARE WOULD NEED TO BE MODIFIED TO SATISFY ARMY ORGANIZATIONAL ASPECTS, DOCTRINE, AND PROCEDURES. SOME OF THESE MODIFICATIONS MAY BE SIGNIFICANT.

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B-13

LS-16-29

(U)   Table 1.5 identifies the advantages and disadvantages of using MIFASS as a replacement for TACFIRE for the heavy divisions. There are 28 division equivalents of TACFIRE in the field, including 32 division sets and 100 battalion sets. [1] The conclusion of this analysis is that MIFASS, as planned for IOC, appears unsatisfactory as a replacement for TACFIRE.

(U)   MIFASS has a number of advantages over TACFIRE. It would potentially simplify the operator interface, reduce training, and decentralize the system by providing computing at all centers. The MIFASS architecture would improve flexibility by permitting functions to be assigned to any terminal and allowing center configurations to be tailored as required. The TACFIRE operator-machine interface is dependent on a complicated set of procedures and abbreviations that must be learned and executed by the operator without explanatory prompts. Training to maintain TACFIRE proficiency in the field requires 10 to 20 hours of hands-on system access per week. [2] TACFIRE provides computational capability only at the artillery CPs, Bn FDC, Div Arty, and Corps Arty. In addition, each center provides only a single workstation connected directly to the central processor. Remote workstations, Variable Format Message Entry Devices (VFMEDs), including those at maneuver FSEs, have no standalone computational capability and must be serviced by the CPU over communications means. MIFASS, as a replacement for TACFIRE, would distribute computational capability to all centers, allowing processes to be performed locally without the necessity for access to a central computer.

(U)   As shown in Table 1.2, MIFASS does not provide several TACFIRE interfaces required by the Army: ATHS, DMD, FIST DMD, Lance, MBC, MLRS, RPV, and JSTARS. MIFASS does not provide division-level functions (e.g. for chemical and nuclear munitions) and corps-level functions required by the Army that are currently in TACFIRE. These functions are essential to supporting the Army's deep battle operations. Replacing TACFIRE with MIFASS appears expensive, as the equipment alone would cost $645 million to $740 million (constant FY 87 dollars). This is comparable to the $975 million already invested in TACFIRE (procurement costs in constant FY 87 dollars). MIFASS equipment does not offer substantial reductions in weight, provide small configurations for maneuver elements, nor provide the degree of automation required to meet the Army high-intensity threat. Some of these disadvantages could be corrected by modifying MIFASS (see Table 1M.1).

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[1] (U) PM FATDS, *Briefing to IDA*, 3 September 1986, UNCLASSIFIED.

[2] (U) USA Field Artillery School, *Demonstration and Discussions on TACFIRE with IDA*, 22-23 October 1986, UNCLASSIFIED.

B-14

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.5 MIFASS AS A REPLACEMENT FOR TACFIRE

- **ADVANTAGES**

  - SIMPLIFIES SOLDIER-MACHINE INTERFACE; POTENTIALLY REDUCES TRAINING

  - POTENTIALLY PROVIDES COMMON PICTURE OF FIRE SUPPORT ACTIVITY AND FRIENDLY UNITS

  - DECENTRALIZES SYSTEM--COMPUTING AT ALL CENTERS

  - IMPROVES FLEXIBILTY--FUNCTIONS CAN BE ASSIGNED TO ANY TERMINAL; CONFIGURATIONS CAN BE TAILORED TO REQUIREMENTS OF EACH CENTER

  - MAY IMPROVE CONOPS THROUGH ECHELONING AND EMPLOYMENT OF NO UNIQUE CRITICAL ELEMENTS

- **DISADVANTAGES**

  - DOES NOT SUPPORT SEVERAL REQUIRED ARMY INTERFACES PROVIDED BY TACFIRE

  - DOES NOT PROVIDE DEGREE OF AUTOMATION REQUIRED TO MEET ARMY HIGH INTENSITY THREAT

  - DOES NOT PROVIDE SUPPORT FOR NUCLEAR/CHEMICAL WEAPONS OR FOR THE REQUIRED CORPS-LEVEL FUNCTIONS PROVIDED BY TACFIRE

  - APPEARS EXPENSIVE (WOULD BE MULTI-BILLION DOLLAR REPLACEMENT PROGRAM)

  - MAY INCREASE WEIGHT

  - DOES NOT PROVIDE SMALL CONFIGURATIONS FOR FSEs AT MANEUVER ELEMENTS

CONCLUSION: MIFASS APPEARS UNSATISFACTORY AS A REPLACEMENT FOR TACFIRE

BW (10-3) 5

(U) Table 1.6a is the first of two charts that examine the degree to which MIFASS can satisfy the Army light division requirements. This chart summarizes the requirements analysis, and the following chart provides a detailed weight comparison.

(U) There is no separate document, outside of AFATDS documentation, that defines unique light division requirements for a fire support system. Three goals for the fire support system to be used at light divisions have been identified by the user's representative, the TSM-FSC3: no dedicated generators, one-person (man or woman) carry for each equipment component, and no additional vehicles for sheltered operations.[1] For AFATDS, the weight goal is addressed by specifying one-person carry for the FST, PLU, and EP (see Table 3A.6c). Preliminary estimates,[2] however, are that one or possibly two vehicles may need to be added to the light division inventory to accomodate AFATDS.

(U) The accompanying table (Table 1.6b) shows that the equipment for TACFIRE in a light division would weigh 16,830 lb, not including the shelter, racks, air conditioners, chemical protective equipment, radios, communications security (COMSEC) devices, vehicles, generators, or other support equipment. Using configurations for centers in the light division with a comparable number of workstations as required for AFATDS. Table 1.6b also shows that MIFASS equipment would weigh 21,950-29,910 lb. This is 30-78 percent more than the TACFIRE equipment. However, TACFIRE does not offer as many workstations as required by the Army for AFATDS (22 versus 42). A scaled-down MIFASS configuration of one Div Arty and three Bn FDCs, each with two workstations, and 14 additional standalone workstations for maneuver elements would weigh 12,140-15,700 lb--72-93 percent of the TACFIRE weight. The conclusion of the analysis is that MIFASS is roughly comparable to TACFIRE in weight.

(U) The Army has determined that TACFIRE is too heavy for the light divisions. Providing a comparable number of workstations as required by the Army, either to match workstations provided by TACFIRE (22) or to meet its requirements for an advanced fire support system (42) using MIFASS, would be 0.7-1.8 times as heavy as TACFIRE. Thus, MIFASS appears to be too heavy for the light divisions.

[1](U) TSM-FSC3, *Discussions with IDA*, 6 October 1986, UNCLASSIFIED.

[2](U) TSM-FSC3, *Discussions with IDA*, 22 October 1986, UNCLASSIFIED.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.6a CAN MIFASS SATISFY ARMY LIGHT DIVISION REQUIREMENTS?

- THERE IS NO SEPARATE DOCUMENT (OUTSIDE OF AFATDS DOCUMENTATION) THAT DEFINES UNIQUE LIGHT DIVISION REQUIREMENTS FOR FIRE SUPPORT SYSTEM

- USER (TSM-FSC3, FT SILL) HAS PROVIDED LIGHT DIVISION GOALS:

  - NO DEDICATED GENERATORS
  - ONE-PERSON CARRY FOR EACH COMPONENT
  - NO ADDITIONAL VEHICLES FOR SHELTERED OPERATIONS

- COMPARISON OF MIFASS AND TACFIRE SHOWS THAT

  - TACFIRE HARDWARE[a] TO EQUIP A DIVISION WEIGHS 16,830 LB
  - TO PROVIDE THE NUMBER OF WORKSTATIONS[b] REQUIRED FOR AFATDS, MIFASS HARDWARE[a] WOULD WEIGH 21,950 TO 29,910 LB, 30-78% MORE THAN TACFIRE EQUIPMENT
  - TO PROVIDE THE WORKSTATIONS CURRENTLY USED IN TACFIRE, MIFASS EQUIPMENT WOULD WEIGH 72-93% AS MUCH AS TACFIRE EQUIPMENT

- TACFIRE HAS BEEN DETERMINED TO BE TOO HEAVY FOR LIGHT DIVISIONS

[a] Does not include shelter, air conditioners, chemical protective equipment, radios, COMSEC, vehicles, generators, or support equipment.
[b] As defined for a light division in Aug 86 Fire Support Automation Plan.

CONCLUSION: MIFASS EQUIPMENT, 0.7-1.8 TIMES AS HEAVY AS TACFIRE EQUIPMENT, APPEARS TOO HEAVY FOR LIGHT DIVISIONS.

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B-17

BW (10-30) 1

(U)   Table 1.6b compares the weight of MIFASS and TACFIRE equipment for an Army light division.   The equipment weights are exclusive of shelters, racks, air conditioners, chemical protective equipment, radios, COMSEC devices, vehicles, generators, or other support equipment.   The left side of the chart summarizes the way elements of a light division could be equipped with TACFIRE. VFMEDs are collocated at Div Arty and Bn FDCs.   There would be 14 VFMEDs for maneuver elements: 1 each at Div Main and Div TAC, 3 at Bde FSEs, and 9 at Bn FSEs.   Each VFMED provides a single workstation.   For the light division, the equipment would weigh 16,830 lb and would provide 22 workstations.

(U)   The configurations for MIFASS and AFATDS are based on the allocation of AFATDS equipment for light divisions.[1] Configurations for light divisions are similar to, but not exactly the same as, those for heavy divisions (compare Table 1.3a).   The variation in weights for the MIFASS hardware is due to uncertainty about whether the Army would use a single string of MIFASS equipment (as in AFATDS) or a double string (as for the Marine Corps).   Only single strings were considered for the lowest echelons, i.e., Bn FSE and Battery CP.   Based on the planned AFATDS configurations with 42 total workstations, the weight of MIFASS for a light division would be 21,950-29,910 lb, 1.30-1.78 times as heavy as the TACFIRE equipment.   The comparable numbers for AFATDS are 5,080-11,400 lb and 0.30-0.68 times as heavy as TACFIRE.

(U)   TACFIRE provides 22 workstations per division, in contrast to the 42 workstations in the configurations described above.   Downsized configurations for light divisions at Div Arty and Battalion FDC with just two workstations each would weigh 1,110-2,000 lb using one to two strings of MIFASS equipment.   The weight of the smallest configuration of MIFASS equipment that supports a workstation, together with a printer and Mass Storage Device, is 550 lb.   Thus the minimum weight of MIFASS equipment to provide computers and workstations as provided in the TACFIRE case would weigh 12,140-15,700 lb.   This is 72 to 93 percent of the TACFIRE equipment for a comparable number of workstations.

(U)   The Army plans to use High Mobility Multipurpose Wheeled Vehicles (HMMWVs) throughout light divisions.   Norden Systems estimates[2] that a single HMMWV can carry a two-workstation center of MIFASS equipment, weighing 1,200-1,500 lb. However, MIFASS equipment in nine of the centers could weigh more than the payload of a shelterized HMMWV for C3 missions (1,600 lb).   Further, the Army estimates that HMMWVs in the planned inventory may not be able to carry personnel, planned equipment, and the AFATDS equipment that weighs one third to two thirds as much as MIFASS.   Therefore, MIFASS equipment may not be transportable by available vehicles.

[1](U) PM FATDS, *Fire Support Automation Plan*, 22 August 1986, UNCLASSIFIED.

[2](U) Norden Systems, *Additional Data Provided to IDA*, 18 September 1986, UNCLASSIFIED.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.6b COMPARISON OF MIFASS AND TACFIRE WEIGHT[a] FOR AN ARMY LIGHT DIVISION

TACFIRE

DIVISION ELEMENTS	#	TOTAL WORK STNS	UNIT[b] (lb)	SUBTOTAL (lb)
DIVARTY	1	2[c]	4,240	4,240
BN SET	3	6[c]	3,170	9,510
Mnvr VFMED	14	14	220	3,080
TOTAL	18	22		16,830

USING PLANNED ARMY LIGHT DIVISION CONFIGURATIONS

DIVISION ELEMENTS	#	TOTAL WORK STNS	MIFASS HARDWARE UNIT[b] (lb)	SUBTOTAL (lb)	AFATDS HARDWARE UNIT (lb)	SUBTOTAL (lb)
DIV MAIN	1	2	1,150-2,030	1,150-2,030	290-680	290-680
DIV TAC	1	2	1,150-2,030	1,150-2,030	290-680	290-680
DIV ARTY	1	3	1,300-2,190	1,300-2,190	350-800	350-800
Bde FSE	3	6	1,150-2,030	3,450-6,090	270-620	810-1,860
Bn FSE	9	9	550	4,950	130-300	1,170-2,700
FA Bn FDC	3	9	1,300-2,190	3,900-6,570	320-680	960-2,040
BATTERY	11	11	550	6,050	110-240	1,210-2,640
TOTAL	29	42		21,950-29,910		5,080-11,400
FRACTION OF TACFIRE				1.30-1.78		0.30-0.68

[a] Does not include shelters, air conditioners, racks, COMSEC, chemical protective and support equipment, or prime movers/vehicles.
[b] Based on data provided by PM FATDS, 3 Sep 86; specifications in TACFIRE technical manuals are up to 15% lower.
[c] Includes VFMED collocated at Div Arty and each of Bn FDCs; in this analysis, the Electronic Tactical Display and Digital Plotter Map were not counted as workstations.

OBSERVATIONS:

- MIFASS EQUIPMENT IS 1.30-1.78 TIMES AS HEAVY AS TACFIRE EQUIPMENT FOR A LIGHT DIVISION

- AFATDS EQUIPMENT, FOR COMPARABLE NUMBER OF WORKSTATIONS AS MIFASS, IS 1/3 TO 2/3 AS HEAVY AS TACFIRE

- WHILE TACFIRE DOES NOT PROVIDE A COMPARABLE NUMBER OF COMPUTERS (4 VICE 42) OR WORKSTATIONS (22 VICE 42), IT WAS APPARENTLY REJECTED BY THE ARMY FOR LIGHT DIVISIONS BASED PRIMARILY ON WEIGHT

- THE REQUIREMENT FOR TACTICAL VEHICLES (E.G., HMMWV) FOR MIFASS WILL BE SIGNIFICANT, SINCE 9 OF THE CENTERS WITH MIFASS EQUIPMENT WEIGH 1,150-2,190 lb (PAYLOAD OF SHELTERIZED C2 HMMWV IS 1,600 lb) AND SINCE AFATDS CENTERS AT LOW WEIGHT ESTIMATE (1/4 TO 1/6 MIFASS) CANNOT BE CARRIED BY AVAILABLE VEHICLES IN THE PLANNED INVENTORY

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BW (11-6) 1a

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(U) Table 1.7 addresses the issue of MIFASS compatibility with the Army Command and Control System (ACCS) common hardware/software concept. Two of the major elements of the ACCS program strategy[1] are to acquire non-developmental item (NDI) hardware and to acquire and integrate common software for all of the ACCS functional systems for the Army Tactical Command and Control System (ATCCS).

(U) A request for proposal (RFP) is planned to be issued in January 1987 for three types of computers: transportable computer unit (TCU), portable computer unit (PCU), and handheld terminal unit (HTU). In addition, the RFP will solicit bids for two types of printers (80-column and 132-column), program load unit (PLU), hard disk unit (HDU), standalone display unit (SDU), and a local area network (LAN).

(U) Of the MIFASS hardware components, only the 80-column printer T2P would appear to meet the RFP requirements, since the T2P is capable of 1,200 lines per minute for an 80-character line. The ACCS TCU and PCU must be based on 32-bit microprocessors (the MIFASS MC is 16-bit). The PLU must be a floppy disk drive (the MIFASS MSD is a magnetic tape unit). MIFASS has no hard disk to meet the HDU requirement. The MIFASS DSD is too heavy for the SDU requirement. The MIFASS Star Coupler and Wire Data Bus may not meet ACCS requirements for a standardized LAN protocol and low weight.

(U) To meet the ACCS software portability goal, the Ada language is required for all new applications. MIFASS applications are written in CMS-2, a standard language for the Navy.

(U) MIFASS, therefore, has limited compatibility with the ACCS common hardware/software concept.

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[1](U) DPM ACCS, *ACCS Overview to LTG Skibble*, 7 November 1986, UNCLASSIFIED.

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.7 IS MIFASS COMPATIBLE WITH ACCS COMMON HARDWARE/SOFTWARE CONCEPT?

HARDWARE

- THE ACCS RFP REQUESTS PROPOSALS ON THE FOLLOWING EQUIPMENT: TRANS-PORTABLE, PORTABLE, AND HAND-HELD COMPUTERS; PRINTERS; PROGRAM LOAD UNITS; HARD DISK; AND STANDALONE DISPLAY

- OF THE MIFASS HARDWARE COMPONENTS ONLY THE 80-COLUMN PRINTER WOULD APPEAR TO MEET THE RFP REQUIREMENTS

SOFTWARE

- IN GENERAL, NEW APPLICATION SOFTWARE TO BE PROGRAMMED IN Ada FOR PORTABILITY

- MIFASS APPLICATION SOFTWARE IS PROGRAMMED IN CMS-2

CONCLUSION: MIFASS HAS LIMITED COMPATIBILITY WITH ACCS CONCEPT

LS-16-2

(U)   Table 1.8 addresses the issue of when MIFASS could be provided to the Army. As currently planned, MIFASS is scheduled to undergo 3 years of preproduction engineering. A production contract would be awarded in FY 90. Three additional years are required for production, which will provide sufficient systems to field MIFASS to the first Marine Amphibious Brigade (MAB) in 1Q FY 93. An alternative program has been developed by the Marine Corps to support an IOC in 1Q FY 92, given appropriate funding and an FY 89 production start. At present, only funds to support the Operational Test have been provided by Congress for MIFASS in FY 87.

(U)   The Army plans to field AFATDS to the light divisions, III Corps, and the training base in FY 90. This initial year represents 30 percent of the total fielding for the Army, based on the procurement cost of the hardware. The Army plans to field to all the remaining corps and divisions, starting with a corps equivalent during FY 91. The FY 90 and 91 fielding represents nearly 50 percent of the total fielding.

(U)   The number of MIFASS components required in Option 1 for the Army is 23,450 to 31,650, depending on whether the Army would use one or two strings of MIFASS equipment. Since the total buy for the Marine Corps is 4,132 components (Table 3B.9a), Option 1 represents a six- to eight-fold increase in MIFASS production. Deliveries for this production would not begin before 1992-1993.

(U)   Therefore, switching to MIFASS would delay the Army's fielding of its next generation fire support system by at least 2 to 3 years. The delay would be longer if accommodating a major production increase causes the production schedule to slip. Some additional time would be required to modify MIFASS to meet Army requirements, since the degree of changes required is extensive (Table 1M.1).

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.8 WHEN COULD MIFASS BE PROVIDED TO ARMY?

- AS CURRENTLY PLANNED, MIFASS SCHEDULE HAS 3 YEARS FOR PRE-PRODUCTION ENGINEERING AND 3 YEARS FOR PRODUCTION, WHICH PROVIDES FIELDING OF THE FIRST MAB SET IN 1Q FY 93. THIS COULD BE ACCELERATED TO 1Q FY 92 GIVEN APPROPRIATE FUNDING AND FY 89 PRODUCTION START

- ARMY CURRENTLY PLANS TO FIELD AFATDS TO LIGHT DIVISIONS AND III CORPS IN FY 90 AND TO OTHER CORPS AND DIVISIONS STARTING IN FY 91

- THE NUMBER OF MIFASS COMPONENTS REQUIRED FOR THE ARMY WOULD BE 6-8 TIMES THOSE REQUIRED FOR MARINE CORPS (23,450 TO 31,650 FOR ARMY VICE 4,132 FOR MARINE CORPS)

CONCLUSION: SWITCHING TO MIFASS WOULD DELAY ARMY'S FIELDING OF ITS NEXT GENERATION FIRE SUPPORT SYSTEM BY AT LEAST 2 TO 3 YEARS, ASSUMING THE INCREASE IN PRODUCTION COULD BE ACCOMMODATED. ADDITIONAL TIME WOULD PROBABLY BE REQUIRED TO MODIFY MIFASS TO MEET ARMY REQUIREMENTS.

(U)   Table 1.9 provides some detailed estimates of the hardware costs for fielding MIFASS to the Army. The basis for the configurations used to field MIFASS to the Army is given in Table 1.3b. The range of estimates in the cost of AFATDS hardware (a total of $281.6 million to $415.6 million in constant FY 87 dollars) is due to differences in cost estimating factors used for ruggedization and uncertainty in the capabilities and cost of the ACCS hardware not yet selected (see Table 3A.8b). The range of estimates in cost shown for each of the two cases of MIFASS equipment are reflections of the current Marine Corps estimate (lower estimate) and the most recent MIFASS life cycle cost study (higher estimate; see Table 3B.9a). MIFASS costs reflect a 90-percent learning curve for the large quantity buys of MIFASS equipment for both Services. Separate average unit costs were computed for each of the two cases (one string or two strings) considered. In the AFATDS program, the Army hardware costs are 69 percent of the total Army procurement costs (Table 3A.8c). Using MIFASS, the hardware costs are 65 percent of the procurement costs for the Army.

(U)   The table shows sensitivity to one of the assumptions about Option 1, whether the Army would use a single string of equipment (as in AFATDS) or a double string (as in MIFASS for the Marine Corps). At the lowest echelons, only a single string of equipment was used for these two cases. For each of the cases, a factor is given that shows the relation of MIFASS hardware costs to AFATDS hardware costs for the Army. The low factor value is the ratio of the low MIFASS cost to the high AFATDS cost. The high factor value is the ratio of the high MIFASS cost to the low AFATDS cost.

(U)   AFATDS hardware for the Army DS Bn FDC costs $0.24-0.39 million. The one-string configuration of MIFASS would cost $0.75-1.04 million for the DS Bn FDC, and the two-string configuration would cost $1.21-1.66 million. For a DS Bn FDC MIFASS would cost 1.9-4.3 times as much as AFATDS using one string, and 3.1-6.9 times as much as AFATDS if two strings of MIFASS are used. Notice that MIFASS equipment at Bn FSE and battery/platoon, which contain the smallest configurations possible to support the required number of workstations, is 5 -11 times as expensive as AFATDS equipment. Averaged over the total force, MIFASS is 2.8-5.9 times as expensive when single-string configurations are used, and MIFASS is 3.2-6.8 times as expensive when double-string configurations are used. The force average is higher than most of the centers shown because equipment at battery/platoon for the Army represents 25 percent of all the fielded equipment (see Table 3A.8a).

OPTION 1 - ARMY FIELDS MIFASS

TABLE 1.9 HOW MUCH WILL MIFASS HARDWARE COST FOR ARMY?[a]

	AFATDS BASELINE ($M)	USING[b] MIFASS ONE STRING COST ($M)	FACTOR	USING[b] MIFASS TWO STRINGS COST ($M)	FACTOR
TOTAL FORCE	281.6-415.6	1,171-1,654	2.8-5.9	1,349-1,906	3.2-6.8
DIVISION EQUIVALENT	4.3-6.4	18.0-25.5	2.8-5.9	20.8-29.3	3.2-6.8
FSEs (HVY DIV)					
CORPS TAC	0.35-0.46	0.65-0.90	1.4-2.6	1.12-1.53	2.4-4.4
CORPS MAIN	0.39-0.51	0.77-1.07	1.5-2.7	1.21-1.66	2.4-4.3
DIV TAC	0.35-0.46	0.65-0.90	1.4-2.6	1.12-1.53	2.4-4.4
DIV MAIN	0.39-0.51	0.77-1.07	1.5-2.7	1.21-1.66	2.4-4.3
Bde FSE	0.28-0.44	1.00-1.41	2.3-5.0	1.33-1.82	3.0-6.5
Bn FSE	0.11-0.16	0.52-0.75	3.3-6.8	0.51-0.75[c]	3.2-6.8
ARTY CPs (HVY DIV)					
CORPS ARTY	0.76-1.05	2.04-2.93	1.9-3.9	2.25-3.18	2.1-4.2
DIV ARTY	0.46-0.61	0.87-1.20	1.4-2.6	1.33-1.82	2.2-4.0
FA Bde HQ	0.52-0.70	1.16-1.65	1.7-3.2	1.78-2.53	2.5-4.9
DS Bn FDC	0.24-0.39	0.75-1.04	1.9-4.3	1.21-1.66	3.1-6.9
BATTERY/PLATOON	0.06-0.09	0.46-0.66	5.1-11.0	0.46-0.66[c]	5.1-11.0

[a] Recurring HW costs only (69% of procurement); all costs are constant FY 87 dollars.
[b] MIFASS costs include 90% learning curve based on large joint buy.
[c] Only one string used at lowest echelon.

CONCLUSION: ON THE BASIS OF A COMPARABLE NUMBER OF WORKSTATIONS, MIFASS WOULD COST BETWEEN 3 AND 7 TIMES AS MUCH AS AFATDS. RANGE IS DUE TO UNCERTAINTY IN RUGGED COMPONENTS FOR AFATDS, TWO ALTERNATIVE FIELDING APPROACHES, AND TWO SETS OF MIFASS COST FACTORS.

(U) The charts in the first part of this Appendix have assessed MIFASS as configured at IOC against stated Army requirements. The issue for the next chart is to identify the changes required to make MIFASS meet the Army needs. Where possible, the scope of these changes is assessed.

OPTION 1M - ARMY
FIELDS MODIFIED MIFASS

- WHAT CHANGES ARE REQUIRED TO MAKE MIFASS

  MEET ARMY NEEDS? (1M.1)

B-27

(U)   Table 1M.1 identifies the changes required to make MIFASS meet Army needs. The previous charts in this Appendix show that MIFASS as planned for IOC will not meet Army requirements in functionality, interfaces, and organization, doctrine, and procedures. Further, the MIFASS hardware does not provide a transportable workstation for remote operations, nor does it provide a small-screen display.

(U)   Modifying MIFASS to attain the software requirements appears feasible but expensive. The extent of these changes suggests that the modifications would take some time. An estimate has been made by Norden Systems for providing the functional and interface software modifications to convert MIFASS software to meet AFATDS Version 1 requirements. The changes would add or modify 180,000 lines of CMS-2 code. This is 114 percent of the code completed for EDM. Using $300 per line of code (LOC), a cost estimating factor used by Calculon for MIFASS, this would cost $54 million.

(U)   The above estimate does not include a number of additional features that would need to be added to the software to meet the Army requirements. Functions are required by the Army at division and corps (planned for AFATDS Version 2) to support nuclear and chemical munitions and deep battle functions (e.g., MLRS and ATACMS). In addition, a query language would need to be added to meet the requirement for the Commander's access to the data bases. Finally, changes would need to be made in the MIFASS software to reflect the Army organization, doctrine, and procedures.

(U)   The hardware configurations need to be modified to support Army requirements by:

- Providing a one-person transportable terminal for remote operations. The terminal must include communications interfaces, display, keyboard, and processor. The smallest configuration using the current MIFASS equipment to provide this capability would weigh 510 lb.

- Providing a small-screen display. The hardware appears to be available, but major software modifications would be required to direct the appropriate text and operator-machine interface to the small-screen display.

- Modifying MIFASS to meet the light division requirements. This would involve extensive reengineering and would probably be expensive.

OPTION 1M - ARMY FIELDS MODIFIED MIFASS

TABLE 1M.1 CHANGES REQUIRED TO MAKE MIFASS MEET ARMY NEEDS

- **SOFTWARE MODIFICATIONS NECESSARY TO PROVIDE AFATDS VERSION 1 FUNCTIONS**
  - Requires addition or modification of 180,000 lines of CMS-2 code (Norden estimate)
  - 158,000 LOCs in EDM version
  - Cost of additional code would be significant ($54 M @ $300 Per LOC)

- **ADDITIONAL SOFTWARE WOULD BE REQUIRED TO SUPPORT**
  - Nuclear/chemical and deep battle (e.g., MLRS and ATACMS) functions
  - Query language to meet Commander's access requirements

- **CHANGE MIFASS SOFTWARE TO REFLECT ARMY ORGANIZATION, DOCTRINE, AND PROCEDURES**

- **AFATDS REQUIRES ONE-PERSON TRANSPORTABLE TERMINAL FOR REMOTE OPERA-TIONS, WITH COMMUNICATIONS INTERFACES, DISPLAY, KEYBOARD, AND PROCESSOR**
  - Smallest configuration of current MIFASS equipment to provide this capability would weigh 510 lb

- **PROVIDE SMALL-SCREEN DISPLAY**
  - Would require major software modification

- **EXTENSIVE REENGINEERING WOULD BE REQUIRED TO MEET LIGHT DIVISION WEIGHT REQUIREMENTS**
  - Would be expensive

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APPENDIX C

DETAILED INFORMATION: MARINE CORPS FIELDS AFATDS
(OPTION 2)

Table 2.0   Major Issues Addressed

Table 2.1   Some Major Marine Corps Functional Requirements vs AFATDS Capabilities

Table 2.2   Interfaces - MIFASS Requirements vs AFATDS Capabilities

Table 2.3a How Much Will AFATDS Hardware Weigh for Marine Corps?

Table 2.3.b Comparison of Environments for Equipment Militarization

Table 2.4   Some Organizational Aspects, Doctrine, and Procedures impacting on the Ability of AFATDS to Meet Marine Corps Requirements

Table 2.5   Is AFATDS Compatible with MTACCS Program?

Table 2.6   When Could AFATDS Be Provided to Marine Corps?

Table 2.7   How Much Will AFATDS Hardware Cost for Marine Corps?

OPTION 1M - MARINE CORPS FIELDS MODIFIED AFATDS

Table 2M.1 Changes Required to Make AFATDS Meet Marine Corps Needs

NOTE: The information in this Appendix was reviewed by the Services on 12-13 November 1986.

(U) Option 2 addresses issues associated with Marine Corps fielding AFATDS. The issues identified in the first part of Table 2.0 establish the degree to which AFATDS as developed for the AFATDS Version 2 IOC will meet the Marine Corps requirements. The other issues are compatibility with other Marine Corps systems and schedule/cost considerations. At the end of this Appendix (Table 2M.1) is a discussion of the changes required in AFATDS to meet the Marine Corps needs.

(U) Marine Corps requirements are examined in four separate areas: functions (Table 2.4); interfaces (Table 2.1); physical characteristics (Tables 2.3a and 2.3b); and organization, doctrine, and procedures (Table 2.4). The central physical characteristics issues are weight (Table 2.3a) and environment (Table 2.3b). In the discussion for Table 2.3a, the methodology used by IDA in developing weight (and cost) estimates for Option 2 is explained.

(U) The Marine Tactical Command and Control System (MTACCS) is an umbrella system of systems that supports command and control for all Marine Corps battlefield functional areas. Table 2.5 addresses the degree to which AFATDS is compatible with the MTACCS concepts being used by the Marine Corps to develop these systems.

(U) Table 2.6 addresses schedule, and Table 2.7 addresses the cost of fielding AFATDS to the Marine Corps' total force.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.0 MAJOR ISSUES ADDRESSED

- HOW WELL DOES AFATDS MEET MARINE CORPS REQUIREMENTS FOR A FIRE SUPPORT SYSTEM?

    - FUNCTIONS (2.1)
    - INTERFACES (2.2)
    - PHYSICAL CHARACTERISTICS (2.3)
    - ORGANIZATION, DOCTRINE, AND PROCEDURES (2.4)

- IS AFATDS COMPATIBLE WITH MTACCS PROGRAM? (2.5)

- WHEN COULD AFATDS BE PROVIDED TO MARINE CORPS? (2.6)

- HOW MUCH WOULD AFATDS COST? (2.7)

BW(10-3)17

(U) Table 2.1 contrasts Marine Corps fire support functional requirements with AFATDS capabilities at IOC. [1] As currently configured, AFATDS would not meet Marine Corps requirements in several areas.

(U) One functional capability not in AFATDS is tube/air conflict processing. Each time the Marine Corps considers firing a mortar or artillery tube on a particular target, the flight profiles of all scheduled Marine Corps air support missions are examined to determine if there will be a time conflict between the shell trajectory and any of the flight legs. If a conflict is detected, it can be resolved by halting the fire until the plane is safely past, by rerouting the aircraft to avoid the conflict, or by overriding the conflict alert and accepting the associated risk. Army doctrine, on the other hand, requires establishment of safe corridors in space and time for close air support missions. These corridors are treated as no fire volumes, and AFATDS would treat them in the same manner as fire support coordination measures.

(U) A group of functions, also not provided by AFATDS, are associated with air mission support and are required to integrate the Marine Corps air support into the combined air/ground operations. This includes not only supporting the offensive air missions but also the transport, medical evacuation, and search and rescue operations. Specifically, it is necessary to generate coordinated flight plans, perform helicopter control, provide aircraft direction, and develop flight profiles for all of the air support missions. AFATDS does not contain these functions since the air support to ground operations is provided by a combination of Air Force aircraft controlled by the Air Force, and Army helicopters controlled via the Army Maneuver Control System.

(U) Another required functionality not provided by AFATDS is providing digital message services to FAAD personnel and disseminating FAAD situation and status reporting to other Marine Corps command, control, and intelligence elements (C2IEs) with a need for the information. In the Army, the FAAD personnel are served by a separate system. This information would be provided through an ACCS interface.

(U) One other possible problem needs to be mentioned. Marine Corps doctrine and procedures require step-by-step operator control of most of the fire support processes. AFATDS processes are highly automated but contain intervention points that may provide the Marines with sufficient control.

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[1] (U) A more detailed breakdown of the functional tasks and the degree to which each system supports them can be found in Appendix A.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.1 SOME MAJOR MARINE CORPS FUNCTIONAL REQUIREMENTS vs AFATDS CAPABILITIES[1]

FUNCTIONS	REQUIRED BY MC	AFATDS IOC (V-2)
FS CONTROL & COORDINATION		
Perform FS Planning (All Assets)	CONV[2]	YES
Attack System Analysis	CONV[2]	YES
TUBE/AIR CONFLICT PROCESSING	YES	NO
TARGET PROCESSING	YES	YES
AIR SUPPORT PROCESSING		
Perform Air Support Processing	YES	NO
Generate Coordinated Air Plans	YES	NO
Perform Helicopter Control	YES	NO
Provide Aircraft Direction	YES	NO
Flight Path Profiling	YES	NO
FA & MORTAR TACTICAL OPERATIONS		
Fire Support Planning	CONV[2]	YES
Attack System Analysis	CONV[2]	YES
Prepare Fire Orders	YES	YES
Support Met and Survey	YES	YES
Status Reporting	YES	YES
POSITION LOCATION INFORMATION PROCESSING	YES	NO
AMMUNITION STATUS AND CONTROL	YES	YES
TECHNICAL FIRE DIRECTION	YES	YES
SUPPORT OF OBSERVER OPERATIONS	YES	YES
FORWARD AREA AIR DEFENSE	YES	NO
EMBEDDED TRAINING	YES	YES

1. Marine Corps doctrine and procedures require hands-on step-by-step control of most fire support processes. The AFATDS processes are highly automated but contain intervention points that may provide the Marine Corps with sufficient control.

2. Nuclear and chemical functions were requirements in the original MIFASS ROC and System Specification but they have been deleted from Production Baseline Specification.

CONCLUSiON: AFA.JS, BY IOC FOR SOFTWARE VERSION 2, WILL CONTAIN ALL FUNCTIONS REQUIRED BY THE MARINE CORPS EXCEPT FOR AIR SUPPORT AND TUBE/AIR CONFLICT PROCESSING, POSITION LOCATION INFOR-MATION PROCESSING, AND FORWARD AREA AIR DEFENSE.

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(U)   Table 2.2 identifies the interfaces required by the Marine Corps for an advanced fire support system. Each of the interfaces listed in the first column of the chart is specified in the MIFASS System Specification[1] with two exceptions. The Tactical Air Operations Module (TAOM) interface was deleted for EDM, but the Marine Corps intends to implement the TAOM interface by IOC. The NATO interfaces were not addressed in the System Specification, but the Marine Corps plans to implement these interfaces through an interface with the forthcoming Army system.

(U)   Not all the Marine Corps required interfaces will be implemented in MIFASS by IOC (FY 92-93). The interfaces for the Tactical Combat Operations (TCO) system have not yet been defined, and the degree to which interfaces must be supported is still to be determined. The MIFASS interface for NATO is to be resolved when interfaces with the Army are resolved. Interface to the Naval Tactical Data System (NTDS) will not be implemented by the MIFASS IOC. The Marine Corps currently plans to implement the TACFIRE protocol and message sets for BCS, Firefinder, and MDS. If the Army does not field AFATDS by MIFASS IOC, the Marine Corps would plan to implement additional TACFIRE messages. (See Table 3B.4.)

(U)   At IOC, AFATDS lacks interfaces to two of the systems that are fundamental to Marine Corps fire support operations: Position Location Reporting System (PLRS) and TAOM. PLRS data are used by the Marine Corps for deconfliction of friendly forces with supporting arms and for air operations. TAOM data are used to coordinate air support for the integrated fire support system. In addition, the AFATDS Version 2 software does not have a provision for interface to MIFASS. The interface to the Digital Communications Terminal (DCT) would be provided by AFATDS under the assumptions that the Marine Corps uses Army software for DCT protocols and messages and that the modems support the required Marine Corps communications media.

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[1](U) Naval Electronics Systems Command, *Contract Specification--Marine Integrated Fire and Air Support System Engineering Development Model (EDM)*, ELEX-M-296E, 15 January 1982, with change pages dated 25 May 1983, UNCLASSIFIED.

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OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.2 INTERFACES - MIFASS REQUIREMENTS vs AFATDS CAPABILITIES

MIFASS INTERFACE REQUIREMENTS	IN MIFASS AT IOC	IN AFATDS SW VERSION 2
POSITION LOCATION REPORTING SYSTEM (PLRS)	YES	NO[1]
BATTERY COMPUTER SYSTEM (BCS)	YES	YES
DIGITAL COMMUNICATION TERMINAL (DCT)	YES	YES[2]
TACTICAL AIR OPERATIONS MODULE (TAOM)	YES	NO
TACTICAL COMBAT OPERATIONS (TCO)	NO	NO
MARINE INTEGRATED FIRE & AIR SUPPORT SYSTEM (MIFASS)	YES	NO
NATO ALLIES	NO[3]	YES
NAVAL TACTICAL DATA SYSTEM (NTDS)	NO	NO
FIREFINDER	YES	YES
METEOROLOGICAL DATA SYSTEM (MDS)	YES	YES
TACFIRE	PARTIALLY[4]	YES

[1] HAS INTERFACE WITH EPLRS FOR DATA TRANSFER.
[2] CHARACTERISTICS OF THIS INTERFACE NOT YET DEFINED - SEE TEXT.
[3] TO BE RESOLVED WHEN INTERFACES WITH ARMY RESOLVED.
[4] BCS, MSD, AND FIREFINDER ALL USE THE TACFIRE PROTOCOL AND EACH UTILIZES A SUBSET OF THE TACFIRE MESSAGE SET.

CONCLUSION: AT IOC, AFATDS LACKS INTERFACES WITH TWO SYSTEMS FUNDAMENTAL TO MARINE CORPS FIRE SUPPORT OPERATIONS: PLRS AND TAOM

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(U)   Table 2.3a shows how much AFATDS hardware would weigh if fielded to the Marine Corps.   Seven types of Marine Corps centers are shown, including the Marine Air-Ground Task Force (MAGTF) Headquarters Supporting Arms Special Staff (MHSASS), FDCs, FSCCs, and the DASC.   The chart shows two estimates for using AFATDS, one in which a single medium-screen display (MSD) is allocated to each center (as for the Army), and another in which an MSD is provided to each workstation in each center (as in MIFASS).   AFATDS equipment in a MAF weigh significantly less than the MIFASS equipment at the same centers: 19-34 percent as much as MIFASS equipment for one MSD per center and 23-41 percent for one MSD per workstation.

(U)   To illustrate the assumptions used to develop AFATDS configurations for the Marine Corps, the equipment for the Bn FDC is as follows.   Using MIFASS, the Marine Corps requires four each of DSDs, CCPs, and SCs; two each of T1Ps, T2Ps, MCs, MMs, PMs, DCEs, and cable sets; one Mass Storage Device (MSD); and 14 BBs.   Using AFATDS, the configurations are one FSCT, three FSTs, one PLU, four EPs, one PCG, one cable set, and one or four medium-screen displays (MSDs).

(U)   The primary assumption is that the Marine Corps would use the same number of workstations with AFATDS equipment as with MIFASS equipment.   Therefore, Marine Corps centers are assigned one FSCT and enough FSTs to bring the total workstations (FSCTs and FSTs) to the number used in MIFASS.   The number of EPs provided is the total of the MIFASS T1Ps and T2Ps.   One PLU, one LAN, and one cable set are provided to each center.[1]   Since the Marine Corps uses a medium-screen display at every workstation, two cases of allocating AFATDS MSDs to Marine Corps centers were considered: a lower bound of one MSD per center, and an upper bound of one MSD per workstation in each center.   MIFASS centers range from two workstations in an MHSASS to nine in a Separate DASC.   Since the AFATDS MSD is comparable to the graphics part of the Marine Corps DSD, no AFATDS large-screen displays were provided to Marine Corps centers.

(U)   Equipment for the DASC is an exception to some of above assumptions about the configurations.   Using MIFASS, the DASC has 9 DSDs, 12 CCPs, 9 T1Ps, 3 T2Ps, 6 MCs, 6 MMs, 2 MSDs, 4 PMs, 24 BBs, 3 DCEs, 6 SCs, and 2 cable sets.   The AFATDS configuration used in this analysis provides 2 FSCTs, 7 FSTs, 2 PLUs, 12 EPs, 2 PCGs, 2 cable sets, and 2 or 9 MSDs.

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[1](U) These assumptions do not provide two identical strings of equipment to support echeloning.   The IDA analysis assumed that an FST and an EP would satisfy Marine Corps echeloning requirements for Option 2.   If not, some FSTs may need to be replaced by FSCTs and some PCGs may need to be added (only one mass storage unit is used by the Marine Corps at each center, and the LAN cables are assumed to be segmented for use by both strings).   Replacing an FST with an FSCT and adding a PCG to each center that echelons would increase the AFATDS equipment weight to 20-40 percent of MIFASS if one MSD per center is used and 25-48 percent if one MSD per workstation is used.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.3a HOW MUCH WILL AFATDS HARDWARE WEIGH FOR MARINE CORPS?

CENTER/ CONFIGURATION	TOTAL NO. REQUIRED	MIFASS ESTIMATE WEIGHT (LB)	AFATDS ESTIMATE			
			ONE MSD PER CENTER		ONE MSD PER WORKSTATION	
			WEIGHT (LB)	FACTOR	WEIGHT (LB)	FACTOR
MHSASS	4	1,890	340-670	.18-.35	390-750	.21-.40
DIV FSCC	4	3,650	550-970	.15-.27	770-1,310	.21-.36
REGT FSCC	13	2,950	510-910	.17-.31	670-1,160	.23-.39
BN FSCC	39	2,030	420-780	.21-.38	480-860	.24-.42
REGT FDC	5	2,830	510-920	.18-.33	720-1,250	.25-.44
BN FDC	22	2,910	470-850	.16-.29	630-1,110	.22-.38
SEP DASC	5	5,030	1,140-1,990	.23-.40	1,520-2,580	.30-.51
MAF SUBTOTAL	~5	55,000	10,200-18,540	.19-.34	12,800-22,700	.23-.41
TOTAL USMC		250,400	47,600-86,500	.19-.35	60,500-106,500	.24-.43

CONCLUSION: ON THE BASIS OF A COMPARABLE NUMBER OF WORKSTATIONS, AFATDS WOULD WEIGH 1/5 TO 2/5 AS MUCH AS MIFASS. RANGE IS DUE TO UNCERTAINTIES IN WEIGHT OF AFATDS.

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C-9

(U) Table 2.3b identifies key environmental requirements[1] for MIFASS equipment and compares them to the floor militarization requirements for the ACCS common hardware/software procurement.[2] Deficiencies in six environmental conditions are highlighted.

(U) The first column in this table identifies the environmental condition, and the second column gives the appropriate MIFASS requirement for that condition. The third column provides the floor values for ACCS Version 1 equipment, i.e., commercial with extended temperature and vibration. The values in the fourth column are for ACCS Version 2, i.e., rugged equipment.

(U) Neither ACCS Version 1 nor Version 2 equipment will meet stated Marine Corps requirements if the equipment only satisfies the procurement floor values. The six primary areas of deficiency are temperature, salt fog, rain, immersion, shock, and lightning. The table highlights these conditions and the associated required values. In most cases, the ACCS procurement has no stated requirement (NSR) for these environmental conditions.

(U) Temperature and shock are the only two of the six cited conditions for which there are stated requirements. Marine Corps stated operating temperature extremes are higher (125°F versus 110°F) and lower (-18°F versus 0°F) than ACCS Version 2 floor values. Storage temperature extremes are much higher (160°F versus 110°F) and much lower (-80°F versus 0°F). For shock, MIFASS has a two-foot drop test requirement on faces and corners of each component. ACCS Version 2 equipment has only a bench handling requirement.

(U) Some of the environmental deficiencies could be met by using transit cases. However, the two operational requirements, temperature and accidental spill, would probably not be satisfied by the transit cases.

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[1](U) Naval Electronics Systems Command, *Contract Specification--Marine Integrated Fire and Air Support System Engineering Development Model (EDM)*, ELEX-M-296E, 15 January 1982, with change pages dated 25 May 1983, UNCLASSIFIED.

[2](U) PM ACCS, *ACCS Common Hardware/Software RFP*, Draft, 7 October 1986; DPM ACCS, ACCS Overview to LTG Skibble, 7 November 1986, UNCLASSIFIED.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.3b COMPARISON OF ENVIRONMENTS FOR EQUIPMENT MILITARIZATION

NSR = "NO STATED REQUIREMENT"

	MIFASS REQUIREMENTS	ACCS COMMERCIAL EXTENDED TEMP[a]	ACCS RUGGED[b] (VERSION 2)
ALTITUDE -- OPERATING -- TRANSIT	15 KFT 25 KFT	10,000 FT 10,000 FT	10,000 FT 10,000 FT
TEMPERATURE-- OPERATING --STORAGE	-18 TO 125°F -80 TO 160°F	40-95°F 0-110°F	0 TO 110°F 0-110°F
SOLAR LOADING	355 BTU/HR/FT² (1,119 W/M²)	NSR	NSR
HUMIDITY	TO 95% RH WITH WATER OR FROST CONDENSATION	10 TO 95% RH	10 TO 95% RH
SALT FOG	OPERATES AFTER MIL-E-16400 TEST	NSR	NSR
RAIN	2 IN/HR FOR NON-OPERATING SHELTERS, WATER SPILL ON OPERATING KEYBOARDS AND CONTROL PANELS	NSR	NSR
IMMERSION	HEAT TO 113°F, IMMERSE IN 3 FT WATER, 2 HOURS (NON-OPERATING)	NSR	NSR
SAND & DUST	OPERATES IN DUST & BLOWING SAND ENVIRONMENT	NSR	300 ± 50 FT/MIN
VIBRATION (MODE)	MILITARY TACTICAL VEHICLES & AIRCRAFT (LOOSE OR MOUNTED)	WHEEL VEHICLES (NON-OPERATIONAL)	TRACK VEHICLES (MSG RECEIVE)
SHOCK	2-FT DROP TEST ON FACES & CORNERS	NSR	BENCH HANDLING
ORIENTATION	NSR	NSR	45° FOR 30 MIN
LIGHTNING	WITHSTANDS TRANSIENTS FROM NEARBY STRIKES	NSR	NSR
EMP	MILSTD FOR OPERATING EQUIPMENT	NSR	HAEMP
TEMPEST	NACSEM 5100; 100 M GUARDED RADIUS	V1T - NACSIM 5100B	NACSIM 5100B
SECURE LIGHTING	NSR	SEE RFP	SEE RFP

[a] ACCS RFP, DRAFT, 7 OCT 86; REVISIONS AS REPORTED BY ACCS FROM "ACCS OVERVIEW TO LTG SKIBBLE," 7 NOV 86.

CONCLUSION: ACCS HARDWARE WILL NOT MEET STATED MARINE CORPS MILITARIZATION REQUIREMENTS, ESPECIALLY TEMPERATURE, RAIN, SALT FOG, LIGHTNING, IMMERSION, AND SHOCK. HOWEVER, SOME REQUIREMENTS MAY BE MET WITH TRANSIT CASES.

BW (10-14) 1

(U)   Many aspects of Army organization, doctrine, and procedures are reflected in the design of the AFATDS system that would impact its ability to support the Marine Corps. In the AFATDS software design, the functions are kept as modular as possible and processes are table driven. However, some code would need to be rewritten. Table 2.4 identifies the more important problem areas, which are described below.

(U)   In terms of organization and doctrine, two AFATDS features impact the ability of MIFASS to support the Marine Corps. First, the OPFAC names are different and would need to be changed. Second, the allocation of equipment and tasks to the Main and TAC CPs are not suitable for the Marine Corps' echeloning concept, described earlier in Table 1.4.

(U)   In terms of procedures, the problem areas are the operator interface and the degree of operator control over the processing. The AFATDS operator actions are minimized. Fire support processes have been designed to run as automatically as possible with a minimum amount of intervention. Each operator has only a keyboard and a small-screen display. The medium- and large-screen displays are reserved for group viewing of the tactical situation. On the other hand, the Marine Corps interface is implemented on a medium-screen display with a touch screen and keyboard with which the operator maintains strong control over every step in the fire support process. The AFATDS system does have intervention points built into its algorithms, primarily for use when the system is used in a training mode or when a particular tactical situation requires more manual control. It has not been shown that the setting of some or all of these intervention switches would give the Marine Corps their desired control over the fire support processes.

(U)   As was the case with MIFASS supporting the Army, AFATDS also has a built-in set of messages, message distribution tables, display screens, and report formats that are tailored specifically to Army organization, doctrine, and procedures. Many of these would need to be changed for Marine Corps operations.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.4 SOME ORGANIZATIONAL ASPECTS, DOCTRINE, AND PROCEDURES IMPACTING THE ABILITY OF AFATDS TO MEET MARINE CORPS REQUIREMENTS

- ## ORGANIZATION AND DOCTRINE

  - SERVICE OPFAC NAMES ARE DIFFERENT AND EMBEDDED IN SOFTWARE

  - MARINE CORPS USES TWO SETS OF EQUIPMENT FOR ECHELONING. ARMY USES BASIC SET FOR MAIN CP WITH AUSTERE VERSION FOR TAC

- ## PROCEDURES

  - CURRENT MARINE CORPS APPROACH REQUIRES STRONG OPERATOR CONTROL OF EACH STEP IN THE FIRE SUPPORT PROCESS, BASED ON PHYSICAL INTER-ACTION WITH AN INTEGRATED AIR/GROUND PICTORIAL REPRESENTATION OF FIRE SUPPORT ON THE BATTLEFIELD ON A MEDIUM-SCREEN DISPLAY; AFATDS AUTOMATED PROCESSES AND LACK OF AN INTEGRATED AIR/GROUND PICTORIAL DISPLAY MAY NOT SATISFY THE MARINE CORPS REQUIREMENT

  - EACH SYSTEM HAS A TAILORED SET OF MESSAGES, DISPLAY SCREENS, AND RE-PORTS, MANY OF WHICH WOULD NOT BE SATISFACTORY FOR THE OTHER SERVICE

  - EACH SERVICE DISTRIBUTES MESSAGES DIFFERENTLY BASED ON ITS ORGAN-IZATION AND SOPs

CONCLUSION: AFATDS SOFTWARE WOULD NEED TO BE MODIFIED TO SATISFY USMC ORGANIZATIONAL ASPECTS, DOCTRINE, AND PROCEDURES. SOME OF THESE MODIFICATIONS MAY BE SIGNIFICANT.

C-13

(U)   Table 2.5 addresses the issue of whether AFATDS meets the compatibility requirements for the Marine Tactical Command and Control System (MTACCS). MTACCS consists of seven Marine Corps command and control systems (see Table 3B.6a), which encompass all battlefield functional areas.   Since key equipment has not been selected and commonality requirements are very general, it is too early to determine if MTACCS compatibility is an issue for fielding AFATDS to the Marine Corps.

(U)   Development of MTACCS systems has limited commonality with the AFATDS development approach.   MTACCS systems currently under development use standard Navy computers and CMS-2, a Navy standard computer programming language. New development starts are likely to use Ada, as with AFATDS. There are similar requirements between ACCS and the End User Computer Equipment (EUCE) being procured for the Marine Corps and proposed for development of the TCO system of MTACCS (see Table 3B.6b). For example, both ACCS and EUCE use an NDI approach and are developing software first on surrogate hardware. Also, both EUCE and ACCS have requirements to run the MS-DOS operating system. Both may be commercial with little militarization. Environmental requirements of TCO equipment for fielding have not been specified. Thus, it is too early to know how compatible the AFATDS and MTACCS capabilities will be.

(U)   According to the Marine Corps Command and Control Master Plan,[1] MTACCS policy requires that "standardization and commonality of hardware and software be used to the maximum practical extent...." This commonality requirement is very general. The degree to which it would be met by AFATDS system components, both hardware and software, will not be known until AFATDS hardware is selected, the use of ACCS common software is determined, and the MTACCS/TCO requirements are better defined.

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[1](U) U.S. Marine Corps, *Marine Corps Command and Control Master Plan*, March 1983, UNCLASSIFIED.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.5 IS AFATDS COMPATIBLE WITH MTACCS PROGRAM?

- MTACCS SYSTEMS USE STANDARD NAVY COMPUTERS. EXISTING SYSTEMS USE CMS-2, A NAVY STANDARD LANGUAGE. NEW STARTS ARE LIKELY TO USE Ada. HOWEVER, END USER COMPUTER EQUIP- MENT (EUCE) IS NOT EXPECTED TO BE STANDARD FOR THE NAVY. BOTH EUCE AND ACCS HAVE REQUIREMENTS TO RUN MS-DOS

- MTACCS POLICY REQUIRES "STANDARDIZATION AND COMMONALITY OF HARDWARE AND SOFTWARE [TO] BE USED TO THE MAXIMUM PRACTICAL EXTENT . . . ."[a]

aU.S. Marine Corps Command and Control Master Plan, March 1983.

CONCLUSION: IT IS TOO EARLY TO DETERMINE IF MTACCS COMPATIBILITY IS AN ISSUE FOR AFATDS.

C-15

LS-16-5

(U) Table 2.6 identifies producibility and schedule risks for AFATDS. Based on planned production rates for the Army, the size of the total Marine Corps fielding requirements, and comparison of fielding schedules, there appears to be time to produce sufficient hardware to meet the Marine Corps' schedule. However, these are some schedule risks, which are described below.

(U) The Army plans to procure equipment for a full corp equivalent per year with fielding beginning in FY 90. The Marine Corps equipment represents only about 10 percent of the total AFATDS buy. For example the Army plans to buy 3,520 FSCTs and FSTs, whereas the Marine Corps needs only an additional 339 of these terminals. The ACCS goal is to purchase a small fraction (10 percent) of a vendor's production capability. Since the Marine Corps requirements add only about 10 percent to the procurement quantities for fielding in years in FY 92-93 and beyond, there appears to be no producibility issue.

(U) However, there are some schedule risks. Very little time is available for the Marine Corps to conduct operational testing between the selection of ACCS and other AFATDS equipment and the Army production decision dates. Six months of operational testing is currently allocated for MIFASS. Furthermore, the Army hardware acquisition plan for AFATDS is still being defined. Specifically, critical environmental, weight, volume, and power characteristics for ACCS equipment are not yet known. ACCS component selection is not expected before 1Q FY 88. The need for and characteristics of AFATDS-unique components (i.e., hardware not available from ACCS) depend on both the ACCS decision and the results of CEP. Examples are the displays and the Power Converter Group. The uncertainties in these development plans are schedule risks for AFATDS, as well as for the Marine Corps fielding AFATDS.

C-16

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.6 WHEN COULD AFATDS BE PROVIDED TO MARINE CORPS?

• **FIELDING FOR ARMY STARTS IN FY 90; SCHEDULE COMPATIBLE WITH MARINE CORPS REQUIREMENTS**

• **ACCS GOAL IS TO PURCHASE ONLY SMALL FRACTION OF VENDOR'S PRODUCTION CAPABILITY**

• **MARINE CORPS REQUIREMENTS ADD ABOUT 10% TO TOTAL AFATDS BUY**

• **HARDWARE ACQUISITION PLAN STILL BEING DEFINED**
  - CRITICAL CHARACTERISTICS OF ACCS COMPONENTS NOT YET KNOWN
  - ACCS COMPONENT SELECTION NOT EXPECTED BEFORE 1Q FY 88
  - NEED FOR AFATDS-UNIQUE COMPONENTS DEPENDS ON ACCS DECISION AS WELL
    AS RESULTS OF CEP

CONCLUSION: MARINE CORPS COULD FIELD AFATDS AT THE SAME TIME AS THE ARMY, WHICH IS CONSISTENT WITH MARINE CORPS SCHEDULE, BUT THIS MAY NOT ALLOW TIME FOR MARINE CORPS TO OPERATIONALLY TEST AFATDS HARDWARE. HOWEVER, SIGNIFICANT AFATDS SCHEDULE RISKS EXIST.

(U) Table 2.7 summarizes the cost of AFATDS hardware that would be fielded to the Marine Corps under Option 2. The assumptions for allocating equipment to the Marine Corps centers are the same as described in Table 2.3a. The basis for these assumptions is that the Marine Corps would use the same number of AFATDS workstations as in the MIFASS system. Table 2.7 shows that AFATDS equipment for the Marine Corps would cost 1/9-1/3 as much as with MIFASS equipment.[1]

(U) Table 2.7 shows the costs of two types of AFATDS configurations. The first cost estimate is based on one AFATDS medium-screen display (MSD) per center. The second cost estimate is based on one MSD per workstation. The first configuration type reflects the approach used in AFATDs; the second is the one used in MIFASS. The cost estimate for each configuration is a range of values reflecting the uncertainty as to how much AFATDS hardware will cost (see Table 3A.8b). With each cost estimate is a cost factor. The low value of the cost factor is the ratio of the low AFATDS cost to the high MIFASS cost. At the other extreme, the high value of the cost factor is the ratio of the high AFATDS cost to the low MIFASS cost. The estimates of costs of MIFASS equipment used in this cost summary were derived from Table 3B.9a in Appendix E.

(U) The hardware for the total Marine Corps, including four training and support sets, would equip nearly five MAFs (Table 3B.5a1). This includes 92 centers: 4 MHSASSs, 4 Div FSCCs, 39 Bn FSCCs, 13 Regt FSCCs, 5 Regt FDCs, 22 Bn FDCs, and 5 DASCs. Using AFATDS, this equipment[2] costs $24.6-40.5 million if one MSD per center is used and $46.8-69.0 million if one MSD per workstation is used. The table shows that AFATDS costs 11-21 percent as much as MIFASS for one MSD per center and 20-35 percent as much for one MSD per workstation.

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[1](U) As indicated in the discussion of Table 2.3a, the IDA configurations assumed that an FST and EP would support echeloning for the Marine Corps. If not, an FST may need to be replaced by an FSCT, and a PCG may need to be added to each center that echelons. This could change the cost of equipment for a MAF to $5.37-9.98 million (11-24 percent of MIFASS equipment) for one MSD per center and $9.93-15.86 million (20-38 percent of MIFASS equipment) for one MSD per workstation. The total hardware cost for the force would be $25.1-46.3 million (11-24 percent of MIFASS equipment costs) for one MSD per center and $47.3-74.8 million (21-38 percent of MIFASS equipment costs) for one MSD per workstation. The overall fractions would be 1/9-2/5 as much as MIFASS equipment.

[2](U) AFATDS equipment for the total force is composed of 102 FSCTs, 237 FSTs, 101 PLUs, 484 EPs, 101 PCGs, 101-339 MSDs, and 101 LAN/cable sets.

OPTION 2 - MARINE CORPS FIELDS AFATDS

TABLE 2.7 HOW MUCH WILL AFATDS HARDWARE COST[a] FOR MARINE CORPS?

CENTER/CONFIGURATION[a]	TOTAL NO. REQ'D	MIFASS ESTIMATE (FY 87 $M) UNIT COST	AFATDS ESTIMATE (FY 87 $M)			
			ONE MSD PER CENTER		ONE MSD PER WORKSTATION	
			COST ($M)	FACTOR	COST ($M)	FACTOR
MHSASS	4	1.28-1.58	.19-.33	.12-.26	.29-.45	.18-.35
DIV FSCC	4	2.87-3.44	.30-.48	.09-.17	.67-.96	.19-.33
REGT FSCC	13	2.69-3.24	.27-.43	.08-.16	.54-.79	.17-.29
BN FSCC	39	1.47-1.55	.20-.33	.13-.22	.29-.45	.19-.31
REGT FDC	5	2.25-2.74	.30-.48	.11-.21	.67-.96	.24-.43
BN FDC	22	1.98-2.45	.26-.43	.11-.22	.54-.79	.22-.40
SEP DASC	5	4.42-5.30	.57-.92	.11-.21	1.22-1.76	.23-.40
MAF SUBTOTAL	~5	42.00-48.95	5.26-8.66	.11-.21	9.82-14.54	.20-.35
TOTAL USMC		196.1-228.8	24.6-40.5	.11-.21	46.8-69.0	.20-.35

[a] RECURRING HW COSTS ONLY (44% OF PROCUREMENT); ALL COSTS ARE CONSTANT FY 87 DOLLARS.

CONCLUSION: ON THE BASIS OF A COMPARABLE NUMBER OF WORKSTATIONS, AFATDS WOULD COST 1/3 TO 1/9 AS MUCH AS MIFASS. RANGE IS PRIMARILY DUE TO UNCERTAINTIES IN COST OF AFATDS COMPONENTS.

BW (10-16) 3

(U) The charts in the first part of this App........ .....re assessed AFATDS as provided at IOC against stated Marine Corps requirements. The conclusion was that (for a v..... .... v reasons A.... ... currently configured for IOC, would not meet the stated Marine Corps requirements. The is....for ...e next two ....arts is identify..... ....change...... ...ured to make AFATDS meet the Marine Corps needs. Where po...... .... the .... the ...e change... is ....

C-20

OPTION 2M - MARINE CORPS FIELDS
MODIFIED AFATDS

- WHAT CHANGES ARE REQUIRED TO MAKE AFATDS MEET MARINE CORPS NEEDS? (2M.1)

C-21

(U) Table 2M.1 describes the types of changes required to make AFATDS meet the Marine Corps needs. The table also indicates the scope of the most important change, namely, adding functions in the software.

(U) Four functions not provided in AFATDS need to be added for the Marine Corps. These functions are listed on the table together with the lines of CMS-2 code as implemented in MIFASS. The functions are: (1) air support processing and procedural direction (20,400 LOC), (2) position location information processing (5,700 LOC), (3) forward area air defense functions (1,300 LOC), and (4) artillery tube/air conflict processing (800 LOC). These four functions total 28,200 lines of CMS-2 code. The Army has estimated the scope of these changes as no more than 40,000 lines of Ada code in AFATDS. Magnavox, in coordination with the Army, has estimated the implementation cost at $3 million.

(U) Additional interfaces are also required; they are not included in the 40,000 lines of Ada code cited above. Two interfaces required by the Marine Corps not in AFATDS at IOC are PLRS and TAOM (TADIL B). These are needed to continuously update friendly unit locations, both ground and air. A hardware and software interface to the Marine Corps Landing Force Integrated Communications System (LFICS) is also needed. The LFICS interface is supported by the Unit-Level Message Switch (ULMS).

(U) Another change needed is to add or modify text and graphics formats to correspond to the displays, reports, and printed messages used by the Marine Corps. AFATDS software is highly modular and most formats are stored as data elements. Therefore, the format changes are expected to affect only a small part of the software. Several additional changes are noted on the continuation page.

C-22

OPTION 2M - MARINE CORPS FIELDS MODIFIED AFATDS

TABLE 2M.1 CHANGES REQUIRED TO MAKE AFATDS MEET MARINE CORPS NEEDS

- ● ADD FUNCTIONS

  - Air Support Processing and Procedural Direction (20.4[a])

  - Position Location Information Processing (5.7[a])

  - Forward Area Air Defense (1.3[a])

  - Tube/Air Conflict Processing (0.8[a])

- ● ADD INTERFACES TO MARINE CORPS' PLRS AND TAOM (TADIL B)

- ● ADD COMMUNICATIONS INTERFACE HARDWARE AND SOFTWARE NECESSARY TO USE THE MARINE CORPS LANDING FORCE INTE-GRATED COMMUNICATIONS SYSTEM (LFICS)

- ● ADD/MODIFY TEXT AND GRAPHIC FORMATS FOR OPERATOR DISPLAYS AND PRINTER

[a]Thousand lines of CMS-2 Code. Total is 28,200 lines. Army estimates this as 40,000 lines of Ada code.

C-23

UNCLASSIFIED

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(U) Another change required to make AFATDS meet the Marine Corps needs is to modify the software to accommodate Marine Corps organization, doctrine, and procedures. Some of these changes appear to be easy to implement in the highly structured and modular software developed for AFATDS, e.g., hooking targets and fire units for immediate fire missions and for reviewing a fire plan; using the Marine Corps names for operational facilities and units; and distributing messages, updates, and data base backups.

(U) The AFATDS software would also need to be modified to emulate the way in which the Marine Corps uses its Dynamic Situation Display. Part of the operator-machine interface needs to be directed to the small-screen display and part to the medium-screen display. Interactions between the two display devices may need to be modified. In addition, some more efficient designs may be required to distribute updates and to modify graphics for the ground and air pictures as used by the Marine Corps.

(U) ACCS and other equipment for AFATDS has not yet been selected. As discussed in Table 2.3b, if the ACCS equipment meets only the "floor" specifications in the proposed RFP, it may not be sufficiently militarized to meet Marine Corps requirements. However, there are some candidate NDI hardware components that could meet most, if not all, of the Marine Corps militarization requirements. Depending on the selected equipment, some additional hardware militarization could be required for the Marine Corps.

(U) Finally, some of the Marine Corps needs that have not yet been developed for MIFASS are already available in AFATDS. The modified point mass ballistics algorithms for technical fire control have already been coded for AFATDS. In addition, the MDS, BCS, and Firefinder interfaces are already in AFATDS. The ballistics algorithm and the three interfaces represent a large fraction of the 60,000 to 70,000 lines of CMS-2 code that are still to be completed in MIFASS.

UNCLASSIFIED

C-24

OPTION 2M - MARINE CORPS FIELDS MODIFIED AFATDS

TABLE 2M.1 CHANGES REQUIRED TO MAKE AFATDS MEET MARINE CORPS NEEDS (CONT'D)

- MODIFY AFATDS SOFTWARE TO ACCOMMODATE MARINE CORPS ORGANIZATION, DOCTRINE, AND PROCEDURES

- USE AFATDS MSD/SSD TO PROVIDE FUNCTIONS OF DSD

- ACCS/AFATDS EQUIPMENT MAY NEED ADDITIONAL MILITARIZATION TO MEET MARINE CORPS REQUIREMENTS

- HOWEVER, MODIFIED POINT MASS AND INTERFACES TO FIREFINDER, MDS, AND BCS SCHEDULED FOR MIFASS P3I ARE ALREADY IN AFATDS (THIS WOULD SAVE 60,000 TO 70,000 LINES OF CMS-2 CODING)

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C-26

APPENDIX D

DETAILED INFORMATION: ARMY FIELDS AFATDS (OPTION 3A)

NOTE: The information in this Appendix was reviewed by the Army on 13 November 1986.

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(U)   Option 3A examines a number of key issues for the Army fielding AFATDS. The numbers shown at the end of each issue refer to the tables in this Appendix that are associated with this issue.

(U)   Table 3A.1 addresses the current status of the AFATDS program and examines the degree to which the hardware and software have been defined, the degree to which both have been developed and tested, and the current plans for the system. Table 3A.2 addresses the development and acquisition approach being used in the AFATDS program for both hardware and software.

(U)   Next, the degree to which AFATDS meets stated Army requirements is addressed. Three areas are examined: functions (Table 3A.3), interfaces (Table 3A.4), and physical characteristics. The most important physical characteristics were found to be weight (Table 3A.5a) and environmental requirements (Table 3A.5b).

(U)   The issue of commonality for AFATDS is addressed by identifying the degree to which ACCS common hardware will satisfy stated Army requirements for AFATDS. Capabilities of ACCS hardware are compared with AFATDS requirements and CEP physical characteristics in Table 3A.6a. Environmental requirements for Version 1 (extended temperature and vibration) and Version 2 (rugged) are compared in Tables 3A.6bV1 and 3A.6bV2. In Table 3A.6c, AFATDS weight and size requirements are compared to the ACCS floor requirements.

(U)   Table 3A.7 addresses the risks associated with producing AFATDS hardware.

(U)   Four charts are used to address the cost of AFATDS. Table 3A.8a summarizes the cost of the baseline (minimum) program and identifies the costs of several excursions from this baseline. Table 3A.8b shows the cost of AFATDS components and identifies cost drivers. Table 3A.8c shows a further breakdown of the research and development costs as well as the procurement funding lines that support AFATDS development and fielding to the force. Both constant dollar and then-year dollar values are given. In Table 3A.8d, a number of observations are made about these program costs.

D-2

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.0 ISSUES

- TO WHAT DEGREE HAS AFATDS BEEN DEFINED/DEVELOPED? (3A.1)

- HOW MODERN A SYSTEM WILL BE FIELDED BY THE AFATDS ACQUISITION APPROACH (3A.2)

- HOW WELL DOES AFATDS, AS DEFINED, MEET THE USER REQUIREMENTS?
  - FUNCTIONS (3A.3)
  - INTERFACES (3A.4)
  - PHYSICAL CHARACTERISTICS (3A.5)

- TO WHAT DEGREE WILL ACCS SATISFY AFATDS REQUIREMENTS?
  - HARDWARE (3A.6a)
  - ENVIRONMENTAL (3A.6b)
  - WEIGHT AND VOLUME (3A.6c)

- WHAT SCHEDULE RISKS EXIST? (3A.7)

- HOW MUCH WILL AFATDS COST? (3A.8)

D-3

(U)   The AFATDS concept is still evolving, but it is substantially documented in the Organizational and Operational (O&O) Plan,[1] Required Operational Capability (ROC),[2] and the A-level (system) specification.[3] Refinements in the concept will be based on the results of the CEP tests, expected in 4Q FY 87.

(U)   Software is being developed (in Ada) before hardware is selected. Advanced development culminating in a Concept Evaluation Program (CEP) began in 1984. Four releases of the CEP software are scheduled, and three have been completed. Release 3 consisted of 460,000 lines of code (LOC). After nearly 5,000 test items, Release 3 had only 40 trouble reports. Release 4 for CEP will be about 750,000 LOC, of which 650,000 LOC were completed by November 1986. Release 4 testing is scheduled to begin in February 1987, and CEP testing is scheduled to be completed by 31 July 1987. CEP software will be modified, ported to production hardware, and fielded as Version 1 to the light divisions and III Corps in 1990. Version 1 IOC is 1Q FY 90. Additional functions will be added and fielded as Version 2 with an IOC of FY 91.

(U)   The hardware being developed for CEP is brassboard and is not intended to be fieldable. For IOC, AFATDS will procure NDI equipment, using a mix of common hardware from the ACCS procurement and AFATDS-unique components to be procured separately. An RFP for ACCS Common Hardware/Software is to be circulated to industry for comment in December 1986 and released for bids in January 1987. Vendor selection is scheduled for 1Q FY 88. The procurement strategy for the AFATDS-unique hardware (medium- and large-screen displays and possibly a power converter group) is not yet defined.

(U)   Developing software first and using NDI equipment for fielding is a new acquisiton approach. AFATDS, while in an early developmental stage, is proceeding in a manner consistent with this approach. As will be discussed later, some hardware requirements (e.g., weight, environment) need to be better defined.

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[1](U) U.S. Army Field Artillery School, *Draft Revised Organizational and Operational Plan (O&O Plan) for the Advanced Field Artillery Tactical Data System (AFATDS)*, 23 June 1986, UNCLASSIFIED.

[2](U) U.S. Army Field Artillery School, *First Draft ROC for the Advanced Field Artillery Tactical Data System*, 27 June 1986, UNCLASSIFIED.

[3](U) PM FATDS, *System Specification for the Advanced Field Artillery Tactical Data System*, CR-CE-0089-001D, 18 September 1985, UNCLASSIFIED.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.1 SUMMARY OF AFATDS STATUS

SYSTEM

- CONCEPT SUBSTANTIALLY DEFINED BY O&O, ROC AND A-SPEC
- TO BE REFINED BASED ON CEP RESULTS

SOFTWARE

- CEP CODING APPROXIMATELY 87 PERCENT COMPLETE
  - 650,000 LOC Completed vs 750,000 Estimated For CEP
  - Version 2 Requires Approximately 600,000 Additional LOC (1,350,000 LOC)
- FUNCTIONAL TESTING/ARMY ACCEPTANCE OF RELEASE 3 (460,000 LOC) COMPLETED
- CEP TEST RESULTS EXPECTED 4Q FY 87
- IOC FOR VERSION 2 IS FY 91

HARDWARE

- CEP IS BDE SLICE; BRASSBOARD NOT FIELDABLE
- IOC
  - Use NDI Equipment
  - Mix of ACCS and AFATDS-Unique Equipment Not Yet Defined
  - Degree of Militarization Not Yet Finalized
  - Procurement Strategy for AFATDS-Unique Hardware Not Yet Defined - MSD, LSD, and PCG
- ACCS RFP DUE OUT 1Q FY 87
- ACCS VENDOR SELECTION SCHEDULED FOR 1Q FY 88

CONCLUSION: AFATDS IS IN EARLY STAGE. PROCEEDING IN A MANNER CONSISTENT WITH NEW ACQUISITION APPROACH. WEIGHT AND ENVIRONMENTAL REQUIREMENTS NEED TO BE BETTER DEFINED IN ROC.

UNCLASSIFIED

D-5

(U) A recent IDA study[1] provided a number of recommendations that should lead to the development and fielding of a modern tactical data system. In each of the following areas, AFATDS is using an approach that is consistent with these recommendations:

- Use Ada for application-unique software
- Use a modular approach to software development
- Develop and test software on surrogate computers
- Exploit a common hardware approach
- Reexamine militarization specifications to ensure they are required
- Delay selection of hardware as long as possible.

(U) The AFATDS approach is not completely consistent with one recommendation: take full advantage of commercially developed products. Indeed, AFATDS is using a uniquely developed operating system and data management system that do not permit the easy use of existing commercial or military developed software packages.

(U) In general, however, AFATDS as currently oriented has the potential to lead to the fielding of a modern system.

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[1](U) *An Independent Review of the Army Tactical Command and Control Systems*, IDA Memorandum Report M-107, August 1985, UNCLASSIFIED.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.2 HOW MODERN A SYSTEM WILL AFATDS APPROACH PROVIDE?

SOME RECOMMENDATIONS FROM 1985 STUDY, "AN INDEPENDENT REVIEW OF THE ARMY TACTICAL COMMAND AND CONTROL SYSTEMS"	AFATDS
USE Ada FOR APPLICATION-UNIQUE SOFTWARE	YES
USE MODULAR APPROACH TO SOFTWARE DEVELOPMENT	YES
DEVELOP AND TEST SOFTWARE ON SURROGATE COMPUTERS	YES
EXPLOIT COMMON HARDWARE APPROACH	YES
REEXAMINE MILITARIZATION SPECIFICATIONS TO ENSURE THEY ARE REQUIRED	YES
DELAY SELECTION OF HARDWARE AS LONG AS POSSIBLE	YES
TAKE FULL ADVANTAGE OF COMMERCIALLY DEVELOPED PRODUCTS	NO

CONCLUSION: AFATDS AS CURRENTLY ORIENTED HAS THE POTENTIAL TO LEAD TO THE FIELDING OF A MODERN SYSTEM.

(U) Table 3A.3 contrasts the major Army functional requirements with the capabilities provided by AFATDS at IOC (software Version 2).[1] The Army requirements are based on considerable field experience with the Field Artillery Digital Automatic Computer (FADAC) and TACFIRE systems. Thus, AFATDS represents a third generation system for automation of fire support processes. The FADAC performed only four functions: technical fire control, survey calculations, meteorological corrections, and sound ranging. The TACFIRE system added preliminary target analysis, non-nuclear fire planning, ammunition status, target intelligence, nuclear target analysis, chemical target analysis, nuclear fire planning, and fallout prediction.

(U) In planning for AFATDS the Army identified a need to provide a total of 27 functions (now reduced to 23), of which 16 of the more important ones are shown on this table. A more complete list is provided in Appendix A. AFATDS includes and greatly extends the functional support provided by TACFIRE. The table shows that, by IOC for Version 2 software, AFATDS will support all major functions required of Version 2 by the Army.

(U) In addition to routine calculations, message handling support generation, and other processing, TACFIRE also executes algorithms termed decision aids. For example, one of these decision aids is used in the target/weapon assignment process. For a particular target, alternative fire support means are reviewed, as well as alternative weapons capable of hitting that target and causing the damage desired by the commander and at the same time protecting areas the commander does not wish to damage. The algorithm identifies the best choice. The recommendation and alternatives are presented to the operator for acceptance or override. Many additional decision aids are provided in AFATDS.

(U) Further, in areas such as target value analysis and prioritization, the Army and the contractor are working to understand how this process is done by humans (supported by computers) and how an expert system could be devised to eliminate the laborious parts of the process and greatly enhance the product. The P3I program for AFATDS contains plans for incorporating these advanced capabilities when they become available. Many other functional refinements are also planned as part of the P3I program, which extends through Version 5 of AFATDS software development.

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[1](U) A more detailed breakdown of the functional task and the degree to which each system supports them can be found in Appendix A.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.3 MAJOR ARMY FIRE SUPPORT FUNCTIONAL REQUIREMENTS vs AFATDS CAPABILITIES

FUNCTIONS	REQUIRED BY ARMY	AFATDS IOC (V-2)
FS CONTROL & COORDINATION		
Determine Plan Guidance	YES	YES
Perform FS Planning	CONV/NUC/CHEM	YES
Attack System Analysis	CONV/NUC/CHEM	YES
TARGET GENERATION PROCESSING		
Determine TA Support Capability	YES	YES
Target Processing	YES	YES
FA TACTICAL OPERATIONS		
Determine FA Ops Concept	YES	YES
Fire Support Planning	CONV/NUC/CHEM	YES
FA Attack System Analysis	CONV/NUC/CHEM	YES
Support Met and Survey	YES	YES
Movement Control/Coordination	YES	YES
Conduct FA Sensor Operations	YES	YES
Status Reporting	YES	YES
FA SUPPORT AND SUSTAINMENT	YES	YES
TECHNICAL FIRE DIRECTION	YES	YES
SUPPORT OF OBSERVER OPERATIONS	YES	YES
EMBEDDED TRAINING	YES	YES

CONCLUSION: BY IOC FOR VERSION 2, AFATDS WILL SUPPORT ALL MAJOR ARMY REQUIRED FUNCTIONS.

UNCLASSIFIED

D-9

LS-17-18

(U)   Table 3A.4 identifies the interfaces required by the Army for an advanced fire support system. Each of the interfaces listed in the first column of the chart is specified in the AFATDS System Specification,[1] except Guardrail CTT. The NATO interfaces specified are to ADLER (Federal Republic of Germany) and BATES (United Kingdom). The JINTACCS interface includes MIFASS.

(U)   Several of the required interfaces use the TACFIRE protocol and a subset of the TACFIRE mesage set: Airborne Target Handoff System (ATHS), Battery Computer System (BCS), Digital Message Device (DMD), Firefinder, Fire Support Team (FIST) DMD, Lance, Meteorological Data System (MDS), Mortar Ballistics Computer (MBC), Multiple Launch Rocket System (MLRS), Remotely Piloted Vehicle (RPV), TACFIRE, and Joint Surveillance Target Acquisition Radar System (JSTARS). Each of these interfaces is in Version 2 of AFATDS. All but ATHS, Lance, and JSTARS are fully provided in the CEP software. Two interfaces are partially provided in CEP: JSTARS and the ACCS/Force Level Control Systems.

(U)   The planned Army interface to the Digital Communications Terminal (DCT) uses different protocols and messages than those developed by the Marine Corps for the DCT. The protocols and messages for the Elevated Target Acquisition System (ETAS) and the Army Tactical Missile System have not yet been determined. Interface to Guardrail CTT would be implemented in the Version 2 software if the interface specifications are available in time. Two of the other required interfaces, not provided in CEP, will be completed in Version 2: Howitzer Improvement Program (HIP) and JINTACCS.

(U)   The only required interface, for which specifications have been defined, that is not implemented in Version 2 AFATDS software is the MIFASS interface.

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[1](U) PM FATDS, *System Specification for the Advanced Field Artillery Tactical Data System*, CR-CE-0089-001D, 18 September 1985, UNCLASSIFIED; this specification contains a markup for CEP.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.4 INTERFACES - AFATDS REQUIREMENTS vs CAPABILITIES

REQUIRED INTERFACES	IN CEP	IN IOC VERSION 2 SW
ACCS AND FORCE LEVEL CONTROL SYSTEMS	P	X
AIRBORNE TARGET HANDOFF SYSTEM (ATHS)	-	X
BATTERY COMPUTER SYSTEM (BCS)	X	X
DIGITAL COMMUNICATIONS TERMINAL (DCT)	-	X
DIGITAL MESSAGE DEVICE (DMD)	X	X
ELEVATED TARGET ACQUISITION SYSTEM (ETAS)	-	T
FIREFINDER	X	X
FIRE SUPPORT TEAM DMD	X	X
GUARDRAIL CTT	-	F
HOWITZER IMPROVEMENT PROGRAM (HIP)	-	X
LANCE	-	X
MORTAR BALLISTICS COMPUTER (MBC)	X	X
METEOROLOGICAL DATA SYSTEM (MDS)	X	X
MULTIPLE LAUNCH ROCKET SYSTEM (MLRS)	X	X
REMOTELY PILOTED VEHICLE (RPV)	X	X
TACFIRE	X	X
JINTACCS	-	X
NATO ALLIES	P	X
JOINT SURV TGT ACQ RADAR SYSTEM (JSTARS)	-	X
ARMY TACTICAL MISSILE SYSTEM (ATACMS)	-	X
MIFASS	-	T

X = CAPABILITY INCLUDED   F = IF INTERFACE SPECIFICAITONS AVAILABLE IN TIME
- = CAPABILITY NOT INCLUDED   T = TO BE DETERMINED
P = PARTIAL CAPABILITY INCLUDED

CONCLUSION: AT VERSION 2 IOC, AFATDS WILL HAVE ALL REQUIRED
INTERFACES FOR WHICH SPECIFICATIONS HAVE BEEN DEFINED, EXCEPT MIFASS.

UNCLASSIFIED

D-11

LS-16-13

(U) Table 3A.5a identifies the hardware components of AFATDS, shows the total number that are planned for procurement for fielding to the total force, and provides two estimates of the component weights. The numbers of components required are those provided by PM FATDS and are consistent with the minimum program defined in the current Fire Support Automation Plan.[1]

(U) The weight estimates were derived from an analysis (see Table 3A.6c) of user stated requirements and the floor requirements defined for the ACCS Common Hardware/Software procurement. In general, the lowest and highest values were used for Table 3A.5a.

(U) Specifically, the lower weights of the components are derived as follows. The Fire Support Computer Terminal (FSCT) is based on the CEP augmented computer unit with small-screen display. The Fire Support Terminal (FST), Electronic Printer (EP), and Large-Screen Display (LSD) are as given by the user (TSM-FSC3 at Fort Sill) as input to the Army Tactical Command and Control System (ATCCS) ROC. The Program Load Unit (PLU) is based on the 10-MB Disk Drive Unit (DDU) used for CEP. The Power Converter Group (PCG) is based on the CEP Power Converter Unit. The MSD is based on an example NDI item available from industry. Finally, the Local Area Network (LAN) is based on a nominal length (150 ft) and weight per unit length of the CEP wire LAN, with no additional allowance for the Installation Kit (IK).

(U) The upper weight estimates for Table 3A.5a were based on data provided by OPM ACCS, with the exception of the MSD, LSD, and LAN/IK. The MSD upper weight estimate is the value provided by the user as input to the ATCCS ROC. The LSD upper weight estimate is based on an example NDI item available from industry. The LAN upper weight estimate is based on the total cable weights for CEP that average 60 lb, with no additional allowance for the Installation Kit.

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[1] (U) PM FATDS, *Fire Support Automation Plan*, 22 August 1986, UNCLASSIFIED.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.5a WEIGHT OF AFATDS COMPONENTS

| | NUMBER PROCURED[a] | LOWER WEIGHT ESTIMATE | | | | UPPER WEIGHT ESTIMATE | | | |
		UNIT (LB)	SUBTOTAL (K LB)	% OF TOTAL		UNIT (LB)	SUBTOTAL (K LB)	% OF TOTAL	
FSCT - Fire Support Computer Terminal	615	60	36.9	9.2		197	121.2	13.9	
FST - Fire Support Terminal	2,905	42	122.0	30.5		65	188.8	21.7	
PLU - Program Load Unit	2,428	9	21.9	5.5		55	133.5	15.4	
EP - Electronic Printer	2,563	42	107.6	26.9		55	141.0	16.2	
PCG - Power Converter Group	615	30	18.5	4.6		42	25.8	3.0	
MSD - Medium-Screen Display	391	54	21.1	5.3		84	32.9	3.8	
LSD - Large-Screen Display	196	84	16.5	4.1		204	40.0	4.6	
Inst Kit/LAN - Installation Kit, includes	3,097	18	55.7	13.9		60	185.8	21.4	
Local Area Net									
TOTAL	12,810[b]		400.2	100.0			869.0	100.0	

[a]BASELINE (MINIMUM PROGRAM) AFATDS.

[b]9,713 "BOXES" PLUS 3,097 INSTALLATION KITS.

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LS-17-31

(U) Table 3A.5b identifies AFATDS environmental requirements from four sources: the O&O Plan, AFATDS ROC, AFATDS System Specification, and CEP System Specification.[1] The AFATDS System Specification is MILSPEC, since it predates the Army decision to use NDI equipment, with a degree of ruggedization below full MILSPEC. Environmental requirements can be expected to be modified for the objective system specification. Unmodified, these requirements would lead to very rugged equipment for AFATDS.

(U) The O&O Plan does not define a specific environmental requirement, but permits ruggedization at less than full MILSPEC. The specifications for the brassboard CEP equipment are basically commercial, with a shock requirement compatible with bench handling.

(U) Highlighted in Table 3A.5b are environmental requirements derived from the AFATDS ROC for rain; sand and dust; vibration; lightning; and nuclear, biological, and chemical (NBC) protection. These appear to be the drivers for the degree of militarization appropriate to NDI equipment for AFATDS. These requirements will be emphasized in analysis of compatibility with ACCS hardware in subsequent charts.

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[1](U) PM FATDS, *System Specification for the Advanced Field Artillery Tactical Data System*, CR-CE-0089-001D, 18 September 1985, UNCLASSIFIED; this specification contains a markup for CEP.

D-14

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.5b AFATDS ENVIRONMENTAL REQUIREMENTS

	O & O PLAN (23 JUN 86)	AFATDS ROC* (27 JUNE 86, DRAFT)	SYSTEM SPEC (18 SEP 85)	CEP SPEC (18 SEP 85)
ALTITUDE-- OPERATING		NO STATED REQUIREMENT TRANSPORT BY AIR	15,000 FT	10,000 FT
-- TRANSIT			50,000 FT	35,000 FT
TEMPERATURE-- OPERATING	"RUGGEDIZED OR MILITARIZED"	0 TO 122°F	-65 TO 131°F	40 TO 100°F
-- TRANSIT		NO STATED REQUIREMENT	-80 TO 185°F	23 TO 131°F
-- SHOCK		NO STATED REQUIREMENT	RAPID TEMP VARIATIONS	N/A
SOLAR RADIATION		NO STATED REQUIREMENT	104 w/ft^2 AT $131°F$	N/A
HUMIDITY		WITHSTANDS 95% RH	3 TO 95% RH WITH WATER, FROST CONDENSATION	10 TO 80% RH, NON-CONDENSING
SALT FOG		OPERATES IN FOG	PROLONGED EXPOSURE AND OPERATION	N/A
RAIN		OPERATES IN RAIN, SLEET, HAIL, SNOW, AND HIGH WINDS	OPERATES IN HEAVY PRECIPITATION WITH INTERMITTENT WIND	N/A
IMMERSION		NO STATED REQUIREMENT	3 FT 2 HRS IN CASES	N/A
SAND & DUST		OPERATES IN SMOKE & DUST	35 KT FINE DUST	N/A
VIBRATION (MODE)		OPERATES IN TRACK AND WHEEL VEHICLES; ON THE MOVE	OPERATES IN ALL TYPES OF GROUND VEHICLES	N/A
SHOCK		NO STATED REQUIREMENT	BENCH HANDLING, VEHICLES & AIRBORNE OPERATIONS; 15 G'S	1-FT DROP UPRIGHT; FALL ON ANY FACE
ORIENTATION		NO STATED REQUIREMENT		
LIGHTNING		OPERATES IN ELECTRICAL STORM	DIRECT & INDIRECT STRIKES	N/A
EMP		NO STATED REQUIREMENT	SURVIVES NUCLEAR ENVIRON INCLUDING EMP	N/A
NBC		WITHSTANDS CBR AGENTS	WITHSTAND CBR CONTAMINATION	N/A
TEMPEST		TEMPEST HARDENED	NACSIM 5100A, 5112	N/A
SECURE LIGHTING		NO STATED REQUIREMENT	BLUE GREEN DISPLAYS & FILTERS	N/A
SOFTWARE SECURITY		ACCEPT EMBEDDED SOFTWARE ENCRYPTION TECHNOLOGY	MAY INCLUDE ENCRYPT/DECRYPT ACTIVITY	N/A

*AFATDS WILL PRIMARILY BE OPERATED INSIDE VEHICLES (ATATDS ROC, APP #1).

CONCLUSION: STATED AFATDS REQUIREMENTS WOULD LEAD TO VERY RUGGED EQUIPMENT

UNCLASSIFIED

(U)   Table 3A.6a is the first of three charts that examine the degree to which ACCS hardware is compatible with AFATDS requirements and the physical characteristics of the CEP equipment. The ACCS equipment consists of a Transportable Computer Unit (TCU), Portable Computer Unit (PCU), Hard Disk Unit (HDU), Program Load Unit (PLU), Electronic Printers (EPs), Standalone Display Unit (SDU), Communications Interface Unit (CIU), LAN, and Handheld Computer Unit (HCU). While some capabilities are stated as floor (minimum) requirements, the actual capabilities of these units will not be known until the vendor is selected (scheduled for 1Q FY 88).

(U)   To meet user requirements for a workstation, the TCU may need to be augmented by a display and keyboard to serve as an FSCT, since neither display nor keyboard is required for a TCU. Some AFATDS centers require memory that exceeds the floor memory requirements of the TCU and PCU; the CEP equipment memory capability exceeds the ACCS floor requirements for memory. The current AFATDS concept makes no use of internal (non-removable) hard disks or floppy disk drives that ACCS is requiring for the PCU. To meet AFATDS requirements for the FSCT using ACCS equipment, the TCU may have to be augmented by a PCU or a standalone display unit (SDU). The SDU option may not be feasible, since the SDU is exempted[1] from the environmental requirements.

(U)   ACCS options may not be satisfactory for the AFATDS Program Load Unit. AFATDS requires a removable media on the order of 8-40 MB (requirement to be refined based on CEP results). The ACCS PLU may be a floppy disk drive on the order of one MB and the only hard disk option would be 120 MB or more.   Further, the ACCS floor requirements do not include a removable medium for the hard disk. ACCS will provide at least two options for printers: 80 and 132 columns. However, the floor requirement for speed is only 120 characters per second or 90 lines per minute for the 80-column printer. The stated AFATDS requirement is 1,200 lines per minute, and the CEP printer is 1,000 lines per minute. Thus, the requirements for the AFATDS PLU and EP may not be met by ACCS hardware (if the floor requirements are not substantially exceeded by the selected equipment).

(U)   The PCG, MSD, and LSD for AFATDS are likely to be AFATDS unique. The SDU would be unsatisfactory as an MSD if it is not sufficiently rugged or does not have touch control. A PCG may be needed for the other AFATDS-unique equipment or to meet special requirements (such as using 400 Hz aircraft power). The LAN may need to be rugged, at a degree not yet specified.

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[1](U) These and other data on ACCS requirements are from the draft RFP of 7 October 1986 and were confirmed in meetings with OPM ACCS at IDA on 13 November 1986 for use in this assessment. A subsequent draft RFP of 3 December 1986 requires the SDU to meet the environmental requirements described in subsequent charts.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.6a AFATDS REQUIREMENTS AND CEP PHYSICAL CHARACTERISTICS vs ACCS CAPABILITIES

COMPONENT	REQUIREMENTS[a]	CEP VALUES	ACCS CAPABILITIES
FSCT	Workstation with enhanced processing and memory; 4 modems	Three 68020 32-bit processors with 14-56 MB RAM	ACCS TCU may have no keyboard or display; 2-16 MB RAM will not provide 200% growth; 3 MIPS
FST	Workstation with 4-12 MB memory; 4 modems	One 68020 processor with 4-16 MB RAM	ACCS PCU may not have enough RAM (2-10 MB provided); 1 MIP; 2 internal floppy disk drives and internal hard disk may not be applicable to AFATDS
PLU	Removable cartridge, mass storage device; unspecified storage, but may be 8-40 MB (based on CEP S/W, data bases)	10-MB removable hard disk (DDU)	ACCS floppy disk options may not have enough storage; ACCS hard disk option is 120 MB and may not have removable media
EP	1,200 lines per minute, 80 columns	Versatec commercial printer, 80 columns, 1,000 lines per minute, 100 points per inch	80 (or 132) columns, 120 characters per second (90 lines per minute) graphics capability; may not be rugged
PCG	Input: 28 VDC; 120/240 1-Ph VAC, 50/60 Hz; 120/208 3-Ph VAC, 50/60 Hz; 400 Hz AC. Output: 28 VDC	Input 28 VDC and 115 VAC/60 Hz	ACCS hardware required to handle 28 VDC and 120 VAC/60 Hz; 220 VAC/50 Hz and AFATDS-unique components may lead to AFATDS-unique PCG
MSD	Not cited in System Spec; requirements from FS Automation Plan	10 x 14-inch screen, 75 lines/inch resolution	ACCS color SDU may not be rugged and may not have touch control; MSD may be AFATDS unique
LSD	1-m (diag) screen with touch control, 50 lines/inch resolution	Not applicable	Not provided by ACCS; mix of LSDs/ MSDs may be revised based on CEP
LAN	Fiber optic	Wire, enhanced IEEE 802.5 protocol, 2 megabits per second	Unspecified "standard" protocol; may not be rugged
COMM I/F	Up to 32 channels (CCS). Comm interfaces may be provided by modems and intercom port in FST, FSCT	Singer modems (4) in some terminals (CCU, ACCU)	CIU may not be a separate component; modems may be provided in TCU & PCU
AMM	Aux Memory Module as required	Not applicable	Not provided by ACCS

[a]System Spec and conversations with user and developer.

(U)   Table 3A.6bV1 is the first of two charts that describes compatibility of ACCS environmental requirements with the AFATDS requirements as defined in the AFATDS ROC and the ATCCS ROC.[1] This chart examines environmental requirements for Version 1 equipment, that is, commercial equipment with extended temperature and vibration requirements. The term "NSR" is used when there are no stated requirements.

(U)   The chart shows that the ACCS environmental requirements[2] are generally consistent with the ATCCS ROC. The exceptions are rain ("operate exposed to precipitation blown into shelter"), sand and dust ("as blown into shelters"), orientation ("any physical orientation"), and Electromagnetic Pulse (EMP) ["survive high-altitude EMP (HAEMP)"], for which there are no stated ACCS requirements.

(U)   The AFATDS ROC has requirements for rain and sand and dust that are not stated for ACCS. In addition, the AFATDS ROC requires operation in tracked as well as wheeled vehicles on the move and operation in electrical storm--none of these is necessarily met by Version 1 ACCS hardware.   Therefore, ACCS Version 1 requirements are not consistent with user requirements as defined by the current AFATDS ROC.

(U)   The ACCS nuclear, biological, and chemical (NBC) protection and secure lighting requirements have not yet been released, so compatibility in this area could not be verified.[3]

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[1](U) TRADOC, *Required Operational Capability for the Family of Army Tactical Command and Control Systems (ATCCS)*, Draft, 31 October 1986, UNCLASSIFIED.

[2](U) Environmental requirements are based on the 7 October 1986 draft RFP and the DPM ACCS briefing to LTG Skibble of 7 November 1986; they are generally consistent with the subsequent draft RFP of 2 December 1986. Two additions are a desired operational temperature range of 33-120°F and a desired storage temperature range of -25-150°F.

[3](U) The 2 December 1986 draft RFP excludes Version 1 equipment from NBC and secure lighting requirements.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.6bV1 AFATDS COMPATIBILITY WITH ATCCS AND ACCS ENVIRONMENTAL REQUIREMENTS, VERSION 1: COMMERCIAL -- EXTENDED TEMPERATURE AND VIBRATION

NSR = "NO STATED REQUIREMENT"

	AFATDS ROC (27 JUNE 86, DRAFT)	ATCCS ROC (31 OCT 86, DRAFT)	ACCS RFP* (7 OCT 86, DRAFT)
ALTITUDE -- OPERATING -- TRANSIT	NSR TRANSPORT BY AIR	OPERATE IN TACTICAL A/C TRANSPORT BY AIR	10,000 FT 10,000 FT
TEMPERATURE -- OPERATING --STORAGE --SHOCK	0 TO 122°F NSR NSR	40 TO 95°F 0-110°F (-25 TO 150°F DESIRED) NSR	40 TO 95°F 0 TO 110°F NSR
SOLAR RADIATION	NSR	NSR	NSR
HUMIDITY	WITHSTANDS 95% RH	OPERATES IN 10 TO 95% RH	10 TO 95%* RH
SALT FOG	OPERATES IN FOG	NSR	NSR
RAIN	OPERATES IN RAIN, SLEET, HAIL,	OPERATE EXPOSED TO PRECIPITATION BLOWN INTO SHELTER	NSR
IMMERSION	NSR	NSR	NSR
SAND & DUST	OPERATES IN SMOKE & DUST	AS BLOWN INTO SHELTER	NSR
VIBRATION (MODE)	OPERATES IN TRACK AND WHEEL VEHICLES; ON THE MOVE	WHEEL VEHICLES, ROUGH TERRAIN; AIRCRAFT	WHEEL VEHICLES (NON-OPERATIONAL)
SHOCK	NSR	NSR	NSR
ORIENTATION	NSR	ANY PHYSICAL ORIENTATION	NSR
LIGHTNING	OPERATES IN ELECTRICAL STORM	NSR	NSR
EMP	NSR	SURVIVE HAEMP	NSR
NBC	WITHSTANDS CBR AGENTS	NSR	SEE RFP
TEMPEST	TEMPEST HARDENED	NACSIM 5100A	V1T - NACSIM 5100B
SECURE LIGHTING	NSR	NSR	SEE RFP
SOFTWARE SECURITY	ACCEPT EMBEDDED SOFTWARE ENCRYPTION TECHNOLOGY	NSR	NO STATED REQUIREMENT

*ACCS ENVIRONMENTAL REQUIREMENTS APPLY ONLY TO TCU, PCU, HDU, PRINTERS, AND PLU (NOT FOR LAN AND SDU); REVISIONS AS REPORTED BY ACCS FROM "ACCS OVERVIEW TO LTG SKIBBLE," 7 NOV 86.

CONCLUSION: ACCS VERSION 1 HARDWARE REQUIREMENTS ARE GENERALLY CONSISTENT WITH ATCCS ROC. HOWEVER, THEY ARE NOT CONSISTENT WITH USER REQUIREMENTS AS DEFINED BY THE CURRENT AFATDS ROC.

BW (10-28) 2

UNCLASSIFIED

(U)   Table 3A.6bV2 is the second of two charts that describes compatibility of ACCS environmental requirements[1] with the AFATDS requirements as defined in the AFATDS ROC and the ATCCS ROC. This chart examines environmental requirements for Version 2 equipment, that is, "rugged."

(U)   Version 2 ACCS requirements, as for Version 1, are generally compatible with the environmental requirements from the ATCCS ROC. The exceptions are a requirement for operation in tactical aircraft, operation exposed to precipitation blown into the shelter, and air droppable, for which ACCS has only a bench handling shock requirement and no rain or tactical aircraft operational requirements.

(U)   The AFATDS ROC differs from the ACCS environmental requirements in several important ways. The AFATDS ROC requires operation to 122 degrees F (versus 110 for ACCS); operation in rain, sleet, hail, snow, and high winds (versus NSR for ACCS); and operation in an electrical storm (versus NSR for ACCS).

(U)   The ACCS NBC and secure lighting requirements have not yet been released, so commpatiblity in this area could not be verified.[2]

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[1](U) Environmental requirements are based on the 7 October 1986 draft RFP and the DPM ACCS briefing to LTG Skibble of 7 November 1986; they are generally consistent with the subsequent draft RFP of 2 December 1986. Three additions are a required operational tempterature range of 33-110°F for the TCU only, a desired operational temperature range of 0-120°F and a desired storage temperature range of -25-150°F.

[2](U) The 2 December 1986 draft RFP specifies that "all V2 equipment must be operable in a mission-oriented protective posture (MOPP) level IV (decontamination survivability is not required)" and excludes Version 2 equipment from secure lighting requirements.

D-20

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.6bV2 AFATDS COMPATIBILITY WITH ATCCS AND ACCS ENVIRONMENTAL REQUIREMENTS, VERSION 2: RUGGED

NSR = "NO STATED REQUIREMENT"

	AFATDS ROC (27 JUNE 1986, DRAFT)	ATCCS ROC (31 OCT 86, DRAFT)	ACCS RFP* (7 OCT 86, DRAFT)
ALTITUDE -- OPERATING -- TRANSIT	NSR TRANSPORT BY AIR	OPERATE IN TACTICAL A/C TRANSPORT BY AIR	10,000 FT 10,000 FT
TEMPERATURE -- OPERATING	0 TO 122°F	0 TO 110°F (120 DESIRED); TCU 33-110°F	0 TO 110°F
--STORAGE	NSR	0-110°F (-25 TO 150 DESIRED)	0 TO 113°F
--SHOCK	NSR	SUDDEN TEMP CHANGES	0-70°F AND 120-70°F IN 10 MIN
SOLAR RADIATION	NSR	NSR	NSR
HUMIDITY	WITHSTANDS 95% RH	OPERATES IN 10 TO 95% RH	10 TO 95% RH
SALT FOG	OPERATES IN FOG	NSR	NSR
RAIN	OPERATES IN RAIN, SLEET, HAIL, SNOW, AND HIGH WINDS	OPERATE EXPOSED TO PRECIPITATION BLOWN INTO SHELTER	NSR
IMMERSION	NSR	NSR	NSR
SAND & DUST	OPERATES IN SMOKE & DUST	AS BLOWN INTO SHELTER	300 ± 50 FT/MIN
VIBRATION (MODE)	OPERATES IN TRACK AND WHEEL VEHICLES; ON THE MOVE	TRACK VEHICLES; ON MOVE (PORTABLE UNIT MSG RECEIVE)	TRACK VEHICLES (TCU & PCU MSG RECEIVE)
SHOCK	NSR	AIR DROPPABLE	BENCH HANDLING
ORIENTATION	NSR	STATIONARY ON ROLLING TERR	45° FOR 30 MIN
LIGHTNING	OPERATES IN ELECTRICAL STORM	NSR	NSR
EMP	NSR	SURVIVE HAEMP	HAEMP
NBC	WITHSTANDS CBR AGENTS	OPERABLE IN CHEM ENVIRON	SEE RFP
TEMPEST	TEMPEST HARDENED	NACSIM 5100A	NACSIM 5100B
SECURE LIGHTING	NSR	NSR	SEE RFP
SOFTWARE SECURITY	ACCEPT EMBEDDED SOFTWARE ENCRYPTION TECHNOLOGY	NSR	NSR

*ACCS ENVIRONMENTAL REQUIREMENTS APPLY ONLY TO TCU, PCU, HDU, PRINTERS, AND PLU (NOT FOR LAN AND SDU); REVISIONS AS REPORTED BY ACCS FROM "ACCS OVERVIEW TO LTG SKIBBLE," 7 NOV 86.

CONCLUSION: ACCS VERSION 2 HARDWARE REQUIREMENTS ARE GENERALLY CONSISTENT WITH THE ATCCS ROC. HOWEVER, THEY ARE NOT CONSISTENT WITH USER REQUIREMENTS AS DEFINED BY THE CURRENT AFATDS ROC.

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(U) Table 3A 6c examines ACCS compatibility with AFATDS requirements in the area of weight and size. The chart gives values of weight and volume for each of the specified components as stated in the System Specification, the user input to the ATCCS ROC, the ATCCS ROC itself, CEP hardware,[1] and example NDI hardware from industry. Th ACCS values are the floor requirements most recently provided by OPM ACCS (7 October 1986).[2] Note that weights and volumes of three components defined in the AFATDS System Specification are not specified in the ROCs: Auxiliary Memory Module (AMM), Communications System Interface (CSI), and Forward Entry Device (FED).

(U) The AFATDS requirements as defined by these sources vary widely. The user input to the ATCCS ROC is based on a one- and two-person (male or female) carry. The ATCCS ROC values are apparently based on a one- or two-man carry. In many cases the CEP brassboard hardware meets the objective system requirements. In the case of the large-screen display, the candidate found in industry does not come close to meeting the stated requirements (204 lb vs 84-150 lb).

(U) The ACCS floor weight requirements for the PCU (FST equivalent) are compatible with the ATCCS ROC, but are significantly larger than specified by the user input to the ATCCS ROC (60-65 lb versus 42 lb). The ACCS floor values for the FSCT are 112 to 197 lb, depending on whether another device (PCU or SDU) is required to make the TCU a workstation. At the high end (197 lb), the ACCS equipment for the FST would be too heavy for AFATDS, based on the user input or the current ATCCS values (84-120 lb). In all cases (except the PLU, if a floppy disk satisfies AFATDS capability requirements), ACCS floor values exceed the AFATDS System Specification requirements.

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[1](U) Magnavox, *AFATDS Final Design Plan FSS/FST Brassboard Product Description Document*, 21 April 1986, UNCLASSIFIED.

[2](U) These are the values available at the time of the briefing to OSD. Different values from the draft RFP of 3 December 1986 are: 174-261 lb (120 desired) for the FSCT and 87 lb (60 desired) for the FST.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.6c AFATDS WEIGHT AND SIZE REQUIREMENTS vs ACCS FLOOR REQUIREMENTS

UNIT	AFATDS SYS SPEC		INPUT TO ATCCS ROC		ATCCS ROC (31 OCT 86)		CEP		EXAMPLE NDr[c]		ACCS RFP (7 OCT 86)	
	WT (lb)	VOL (cu ft)	WT (lb)	VOL (cu ft)	WT (lb)	VOL (cu ft)	WT (lb)	VOL (cu ft)	WT (lb)	VOL (cu ft)	WT (lb)	VOL (cu ft)
FSCT	15	0.23	84	-	120	-	60-102[a]	1.72	55	1.79	112-197	4.5-7.5
FST	12	0.69	42	-	60	-	50-94[a]	1.02	30	0.65	60-65	2.0-3.0
LAN	TBD	-	-	-	-	-	0.12[b]	-	-	-	-	-
EP	30.9	0.99	42	-	-	-	75	3.33	-	-	55	1.5
LSD	150	3.62	84	-	-	-	-	-	204	4.33	-	-
MSD	-	-	84	-	-	-	80	1.76	54	1.48	-	-
PLU	15	0.67	42	-	-	-	9	0.24	11	0.41	5-55	0.1-0.7
PCG	35	1.48	42	-	-	-	30	0.75	-	-	-	-
AMM	5[d]	0.06	-	-	-	-	-	-	-	-	-	-
CSI	113[d]	6.29	-	-	-	-	-	-	-	-	-	-
FED	5	0.06	-	-	-	-	-	-	4	0.5	8	0.12

[a] Lower bound is CU or ACU plus SSD; upper bound is CCU or ACCU plus SSD (the larger units have Singer CCS modems).
[b] Per foot.
[c] Magnavox and LORAL/Rolm brochures.
[d] Not cited for deployment in Army Fire Support Automation Plan.

CONCLUSION: SIZE AND WEIGHT OF ACCS COMPONENTS EXCEED AFATDS USER'S INPUT TO ATCCS ROC AND AFATDS SYSTEM SPECIFICATIONS.

(U)   Table 3A.7 addresses the risks associated with developing and producing AFATDS. As previously noted, there are significant differences between the requirements expressed by the user (TSM-FSC3) and the draft requirements in the ATCCS ROC and ACCS Common Hardware/Software statement of work.   Neither the floor weight requirements nor the degree of militarization appears to have been finalized. The schedule for issuing the RFP has slipped from 1Q FY 87 to 2Q FY 87, and the selection of ACCS vendor is still a year away. A detailed AFATDS schedule is provided in Appendix F.

(U)   A number of development decisions depend on two activities that will not be completed until the end of FY 87 or the beginning of FY 88, namely the receipt of results from CEP tests (4Q FY 87) and ACCS award (1Q FY 88). Development decisions contingent on these activities include the determination of the size and distribution of data bases for each center, as well as the functions to be performed at each center. These are drivers for the requirements in memory size, processor throughput, and program load unit size. The mix and characteristics of medium- and large-screen displays will be reassessed based on CEP results. The selection of AFATDS components from ACCS depends on the degree to which those components are compatible with AFATDS requirements (see Table 3A.6a).   Waiting until the end of 1987 to develop detailed requirements and an RFP for AFATDS-unique equipment creates a schedule risk for readiness for operational testing and meeting the IOC.

(U)   There are three parallel activities in FY 88 and FY 89: ACCS procurement and testing, developing and integrating Version 1 software, and developing and integrating Version 2 software. Slips in the planned date for the ACCS award would cause slips in the availability of hardware for system integration, which would probably result in slippage of the operational tests and the IOC. A limited developmental test, an operational test, Milestone III, first unit equipped, and the IOC are scheduled for the period 3Q FY 89 to 1Q FY 90. Very little time is available to modify AFATDS between those tests and the planned IOC.

(U)   To support procurement of equipment for light divisions, III Corps, and the training base, funds are programmed for AFATDS procurement starting in FY 88. The FY 88 funds ($84.7 million) represent 30 percent of the total hardware procurement. FY 89 funds ($55.5 million) represent an additional 19.7 percent of the hardware procurement. Thus, a substantial fraction (30 to 50 percent) of the hardware procurement funds are programmed before the Milestone III decision.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.7 WHAT AFATDS SCHEDULE RISKS EXIST?

- **SPECIFICATIONS FOR ACCS COMMON HARDWARE HAVE NOT YET BEEN DETERMINED**

  - User Requirements (e.g., Weight, Militarization) Not Yet Finalized
  - RFP Still Being Drafted
  - Component Selection Still a Year Away

- **NEED FOR AFATDS-UNIQUE COMPONENTS DEPENDS ON ACCS DECISION AS WELL AS RESULTS OF CEP**

- **START OF AFATDS HARDWARE PROCUREMENT AND TESTING PHASE PLANNED FOR 4Q FY 87. PROVIDES LITTLE TIME TO ACCOMMODATE FURTHER SLIPS IN ISSUING ACCS RFP AND SELECTING COMMON HARDWARE COMPONENTS. DELAY OF RFP BEYOND DEC 1986 OR PROLONGED NEGOTIATIONS OF CONTRACT WOULD DELAY AFATDS DEVELOPMENT**

- **30 TO 50 PERCENT OF HARDWARE PROCUREMENT FUNDS PRO-GRAMMED PRIOR TO MILESTONE III**

CONCLUSION: SIGNIFICANT SCHEDULE RISKS EXIST FOR AFATDS DUE TO UNCERTAINTY OF COMMON HARDWARE TO BE PROVIDED BY ACCS.

LS-19-35

(U)   The estimate of the cost of equipment for the baseline (minimum) AFATDS program as developed by the Army is about $282 million; this cost, outlined in the box on Table 3A.8a, is the cost presented by PM FATDS (in constant FY 87 dollars) at the 7 October 1986 briefing to OSD. As noted in the following charts, this cost does not seem to be based on equipment with sufficient ruggedization to meet the user requirements. IDA has generated a second estimate of $416 million, which uses cost estimating factors that provide for increased costs of rugged equipment. The bases for these two cost estimates are provided in Table 3A.8b. The IDA estimate is 48 percent larger than the Army estimate.

(U)   IDA considered three excursions to the baseline program. In one excursion, IDA considered the impact of deleting the AFATDS equipment designated for use at battery, either for the Battery Command Post (CP) or the Platoon CPs supporting battery. At this level, there would be a direct interface to the BCS. Based on the Fire Support Automation Plan,[1] there are about 1,200 battery sets (i.e., FST, PLU, and EP) that cost $73-108 million and represent about 25 percent of the baseline program.

(U)   The Fire Support Automation Plan defines an extension to the baseline of "required" elements at each center. This "required" program provides additional FSTs and EPs to light divisions and provides the same equipment to reserve units as to active units. The "required" program adds 840 FSTs, 300 EPs, and 730 Installation Kits/LANs. The cost is $325-475 million, $43-59 million more than the baseline (minimum) program, or an additional 15 percent.

(U)   The baseline program does not include equipment for Prepositioning Overseas Materiel Configured in Unit Sets (POMCUS) or war reserve. At 16 percent, this would add $45-66 million to the baseline. According to OPM FATDS, the NDI production lines could represent a war reserve for AFATDS.

(U)   Adding all the required equipment, POMCUS, and war reserve as estimated in this chart would increase the AFATDS baseline equipment cost by about one third.

_____
[1](U) PM FATDS, *Fire Support Automation Plan*, 22 August 1986, UNCLASSIFIED.

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.8a HOW MUCH WILL AFATDS HARDWARE COST?

	COST[1]	DELTA TO BASELINE	
		COST[1]	%
DELETE EQUIPMENT AT BATTERIES/ PLATOONS	$209[1]-308[2]	($73-108)	(25)
BASELINE (MINIMUM PROG)	282[3]-416[2]	-	-
REQUIRED PROGRAM	325[3]-475[2]	43-59	15
WAR RESERVE AND POMCUS	327[3]-482[2]	45-66	16

CONCLUSION: THE EQUIPMENT AT BATTERY LEVEL REPRESENTS 25% OF THE AFATDS BASELINE (MINIMUM PROGRAM) HARDWARE COST. ADDING WAR RE-SERVE, POMCUS, AND ADDITIONAL REQUIRED EQUIPMENT WOULD INCREASE AFATDS BASELINE EQUIPMENT COST BY ABOUT ONE-THIRD.

[1]CONSTANT FY 87 DOLLARS IN MILLIONS.
[2]INCLUDES ADDITION TO EQUIPMENT COSTS TO ACCOUNT FOR VERSION 2 RUGGED EQUIPMENT.
[3]BASED ON PM FATDS VALUES.

UNCLASSIFIED

D-27

LS-17-27

(U)   Table 3A.8b provides detail for the equipment costs presented in the previous chart for the baseline (minimum) program. The lower estimate is based on data provided by OPM FATDS and is consistent with the costs presented in the 7 October 1986 briefing to OSD. The upper estimate is one developed by IDA using different cost factors explained below.

(U)   The lower cost estimate for the equipment is based on quantities needed to support the baseline (minimum) program defined in the Fire Support Automation Plan and is the unit cost estimate provided by PM FATDS. The average costs reflect the slight impact of a new competition for equipment in the fifth year of procurement. The cost of integration and assembly is included in the cost of the Installation Kit/LAN. The FSCT is based on the ACCS TCU, which may have no keyboard or display. The TCU costs include one memory board and no modems. The FST is based on the ACCS PCU with four memory boards and four modems. The PLU cost was based on an ACCS small hard disk unit that is no longer planned for the initial ACCS procurement. Costs of ACCS equipment were increased by __[1] percent over "pure commercial" to account for "repackaging for shock mounting to meet track vehicle requirements" and decreased by __[1] percent to account for a quantity buy. For the AFATS-unique equipment, the Army estimated the MSD and LSD based on engineering estimates provided by Magnavox and estimated the PCG based on the Norden Systems' power module.

(U)   The upper cost estimate for equipment was developed by IDA using some different cost factors. The FSCT was assumed to be a workstation and the cost was based on the combination of both a TCU and PCU rather than the TCU alone; this provides five memory boards, four modems, keyboard, and display to the FSCT. IDA used 1.5 times the cost of the small hard disk as an esimate of the cost of a larger hard disk since no data for a large hard disk was provided by the Army. The cost factors for ACCS equipment (TCU, PCU, PLU/HDU, and EP) were increased by __[1] percent to account for additional cost of ruggedizing the equipment. This effectively increased the ruggedization factor from __[1] to 2.0. The upper estimate for the PCG is the current estimate for the power module, and the MSD unit cost is based on the upper bound of a cost range recently provided to IDA by Magnavox.

(U)   The cost driver is the FST. The FST cost is about one third of the total equipment cost for AFATDS. The combined cost of the two displays (MSD and LSD) is the next most expensive element of the configuration; it is over one fifth of the total equipment cost.

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[1](U) These values are considered by OPM FATDS as procurement sensitive and are omitted from this report.

D-28

OPTION 3A - ARMY FIELDS AFATDS

TABLE 3A.8b COST OF AFATDS COMPONENTS[a]

	NUMBER PROCURED[b]	LOWER COST ESTIMATE			UPPER COST ESTIMATE		
		UNIT ($K)	SUBTOTAL ($M)	% OF TOTAL	UNIT ($K)	SUBTOTAL ($M)	% OF TOTAL
FSCT - Fire Support Computer Terminal	615	..	..	..	..	..	..
FST - Fire Support Terminal	2,905	..	..	..	..	..	..
PLU - Program Load Unit	2,428	..	..	..	..	..	..
EP - Electronic Printer	2,563	..	..	..	..	..	..
PCG - Power Converter Group	615	..	..	..	..	..	..
MSD - Medium-Screen Display	391	..	..	..	..	..	..
LSD - Large-Screen Display	196	..	..	..	..	..	..
Inst Kit/LAN - Installation Kit, includes Local Area Net	3,097	..	..	..	..	..	..
TOTAL	12,810[c]		281.6	100.0		415.6	100.0

[a] ALL COSTS ARE CONSTANT FY 87 DOLLARS.

[b] BASELINE (MINIMUM PROGRAM) AFATDS.

[c] 9,713 "BOXES" PLUS 3,097 INSTALLATION KITS.

NOTE: ".." INDICATES PROCUREMENT SENSITIVE DATA THAT WAS REMOVED.

LS-17-32a

(U) Table 3A.8c summarizes all the projected costs (not just hardware) of both the baseline (minimum) and the "required" programs as provided by the Army (the required program is discussed in Table 3A.8a). The first three major columns are in constant FY 87 dollars, and the last two columns are in then-year dollars. This chart includes funding from RDT&E (FY 87-89) and Other Procurement, Army (FY 88-92). Development costs beyond Version 2 software (FY 90 and later) were excluded.

(U) Subtotals (in constant FY 87 dollars) are provided on the left side of the chart for the baseline (minimum) program. "Other recurring costs" of $28.2 million included $8.5 million for hardware warrantees (3 percent of recurring hardware), $11.8 million for engineering changes (4.2 percent of recurring hardware), and $7.9 million for documentation (3 to 4 percent of recurring hardware). Software modifications (which may include some systems engineering) are $20.3 million. Other nonrecurring costs for the minimum program total $52.7 million and include setting up production lines, initial tests, other hardware and test equipment, and program management. Initial spares for the minimum program (9 percent of recurring hardware) are $22.9 million, giving a total procurement funding line of $405.7 million. RDT&E for software Versions 1 and 2 is $49.1 million and $35.8 million for other items.

(U) The difference between the minimum program and the required program is shown in the second major column as the "delta." The total delta of $64.6 million includes $30 million over the $34.7 million of recurring hardware. The total minimum program is $490.6 million and required program is $555.2 million in constant FY 87 dollars, based on Army estimates. The value of the minimum program in then-year dollars in $552.6 million, including $464.4 million for procurement. The highlighted values are those provided by the Army in the 7 October 1986 briefing to OSD.

D-30

OPTION 3A - ARMY FIELDS AFATDS
TABLE 3A.8c COST OF AFATDS MINIMUM AND REQUIRED PROGRAMS

HARDWARE RECURRING

	NUMBER	UNIT COST (SK)	MIN PROG TOTAL COST ($M)
FSCT	615	. . .	. . .
FST	2,905	. . .	. . .
PLU	2,428	. . .	. . .
EP	2,563	. . .	. . .
PCG	615	. . .	. . .
MSD	391	. . .	. . .
LSD	196	. . .	. . .
IK-LAN	3,097	. . .	. . .

	CONSTANT FY 87 $			THEN-YEAR $	
	MIN PROG	DELTA	REQ'D PROGRAM	MIN PROG	REQ'D PROGRAM
HARDWARE RECURRING	281.6	34.7	316.3	321.5	364.9
OTHER RECURRING	28.2	3.5	31.7	32.1	36.4
HW Warantees (3% HW) 8.5					
Engineering Changes (4.2% HW) 11.8					
Documentation (3-4% HW) 7.9					
SOFTWARE MODIFICATIONS	20.3	8.1	28.4	23.5	33.6
OTHER NON-RECURRING	52.7	15.5	68.2	61.1	80.4
Production Line Equipment 4.3					
Initial Tests (4 Prod Lines) 14.7					
Other HW, Test Equipment 25.5					
Program Management 8.2					
INITIAL SPARES	22.9	2.8	25.7	26.2	29.7
TOTAL PROCUREMENT	405.7	64.6	470.3	464.4	545.0
RDT&E (FY 87-89)	84.9		84.9	88.2	88.2
Software Development 49.1					
Other RDT&E 35.8					
TOTAL PROCUREMENT & RDT&E	490.6	64.6	555.2	552.6	633.2

NOTE: " . . ." indicates procurement sensitive data was removed.

(U)   Table 3A.8d summarizes some of the cost issues identified in previous charts; costs cited are in constant FY 87 dollars.

(U)   The cost of hardware as currently estimated by the Army for AFATDS appears to be based on meeting only the equivalent of Version 1 ruggedization, namely extended temperature and vibration. Specifically, the Army assumes a cost factor of __ 1 over "pure commercial" for "repackaging for shock mounting to meet track vehicle requirements." Since the Version 1 vibration requirement is for wheeled vehicles and Version 2 is for both track and wheeled vehicles, the actual vibration capability assumed for this cost factor is above Version 1. However, it does not address the many other AFATDS environmental requirements (see Table 3A.6bV2). Based on discussions with a number of contractors, IDA estimates the cost factor for ruggedization could be as much as 2.0. The cost of increasing the ruggedization factor to 2.0 for ACCS hardware (8,500 units) is $64.8 million.

(U)   The cost factors used for the FSCT may not be sufficient to satisfy the user (TSM-FSC3) requirement for the FSCT to be a workstation. The degree to which the TCU is actually a workstation may not be known until the ACCS award is made in 1Q FY 88. Adding a PCU to account for the items that may be needed to make the TCU an FSCT would cost about $21 million.

(U)   The difference between the minimum program presented in the 7 October 1986 briefing to OSD and the "required" program described in the Fire Support Automation Plan is, according to Army estimates, $64.6 million.

(U)   Adding a 16-percent POMCUS and war reserve to the baseline (minimum) program would cost $45 million, based on Army cost factors (as much as $66 million using higher cost estimates developed by IDA).

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[1](U) These values are considered by OPM FATDS as procurement sensitive and are omitted from this report.

OPTION 3A - ARMY FIELDS AFATDS
TABLE 3A.8d COST[a] OBSERVATIONS

- COSTS OF HARDWARE PROVIDED BY ACCS APPEAR TO BE BASED ON MEETING ONLY VERSION 1 VIBRATION REQUIREMENTS

  - ACCS HARDWARE REPRESENTS 47% OF AFATDS BUY

  - ... ALLOWANCE OVER "PURE COMMERCIAL" FOR "REPACKAGING FOR SHOCK MOUNTING TO MEET TRACK VEHICLE REQUIREMENTS"

  - NO OTHER ALLOWANCE ASSUMED BY PM FATDS IN COST ESTIMATES FOR HARDWARE PROVIDED BY ACCS

  - COST OF AN ALLOWANCE OF ADDITIONAL ... TO ACHIEVE VERSION 2 SPECIFICATIONS FOR ACCS HARDWARE (8,500 UNITS) IS $64.8 M[b] FOR HARDWARE

- PM FATDS COST ESTIMATES FOR FSCT ARE BASED ON ACCS TCU, WHICH MAY HAVE NO KEYBOARD AND NO DISPLAY

  - USER (TSM-FSC3) HAS TOLD IDA THAT EVERY TERMINAL SHOULD BE A WORKSTATION

  - COST AND WEIGHT OF ALTERNATIVES (STAND-ALONE DISPLAY/KEYBOARD OR ADDITIONAL FST) ARE SIGNIFICANT (ABOUT $21 M)

- PROGRAM COST IN PM FATDS' BRIEFING DID NOT INCLUDE $64.6 M TO PROVIDE ALL REQUIRED COMPONENTS IDENTIFIED IN THE AUG 86 FIRE SUPPORT AUTOMATION PLAN PROVIDED TO CONGRESS

- PROGRAM COST IN PM FATDS' BRIEFING DID NOT INCLUDE POMCUS AND WAR RESERVE (ESTIMATED BY TSM-FSC3 AT 16% OF OTHER HARDWARE; THE NDI PRODUCTION LINE MAY BE CONSIDERED AS THE WAR RESERVE)

[a]ALL COSTS ARE IN CONSTANT FY 87 DOLLARS
[b]VALUE NOT SHOWN ON TABLE 3A.8c

D-33

UNCLASSIFIED

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D-34

APPENDIX E

DETAILED INFORMATION: MARINE CORPS FIELDS MIFASS

NOTE: The information in this Appendix was reviewed by the Marine Corps on 12 November 1986.

E-1

(U)   Option 3B examines a number of key issues for the Marine Corps fielding MIFASS. The numbers shown at the end of each issue refer to the tables in this Appendix that are associated with that issue.

(U)   Table 3B.1 addresses the status of the MIFASS program and examines the degree to which the hardware and software have been defined, the degree to which both have been developed and tested, and the current plans for developmental and operational tests of the system. Table 3B.2 addesses the development and acquisition approach used in the MIFASS program for both hardware and software.

(U)   Next, the degree to which MIFASS meets stated Marine Corps requirements is addressed. Three areas are examined: functions (Table 3B.3), interfaces (Table 3B.4), and physical characteristics. The most important physical characteristics were found to be weight and environmental requirements. Weights for centers (Table 3B.5a1) and for components (Table 3B.5a2) are followed by a summary of the environmental requirements (Table 3B.5b).

(U)   The issue of commonality for MIFASS is addressed by identifying the other systems that comprise the Marine Corps Tactical Command and Control System (MTACCS) and indicating whether there are requirements for commonality of hardware or software (Table 3B.6a). Compatibility of MIFASS equipment with the Tactical Combat Operations (TCO) system of MTACCS is addressed separately (Table 3B.6b).

(U)   Table 3B.7 addresses the risks associated with producing MIFASS hardware. Table 3B.8 examines survivability in terms of the relation between the large number (four) of critical components in a MIFASS string and the ability to echelon.

(U)   Three charts are used to address the cost of MIFASS. Table 3B.9a shows the cost of MIFASS components and identifies cost drivers. Table 3B.9b shows the equipment and other portions of the research and development as well as the procurement funding lines that support MIFASS development and fielding to the force. Both constant dollar and then-year dollar values are given. In Table 3B.9c, a number of observations are made about these program costs.

E-2

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.0 ISSUES

- TO WHAT DEGREE HAS MIFASS BEEN DEFINED/DEVELOPED? (3B.1)

- HOW MODERN A SYSTEM WILL BE FIELDED BY THE MIFASS ACQUISITION APPROACH? (3B.2)

- HOW WELL DOES MIFASS MEET THE MARINE CORPS REQUIREMENTS?
  - FUNCTIONS (3B.3)
  - INTERFACES (3B.4)
  - PHYSICAL CHARACTERISTICS (3B.5)

- TO WHAT DEGREE WILL MIFASS BE COMMON WITH OTHER MARINE CORPS SYSTEMS? (3B.6)

- TO WHAT DEGREE IS MIFASS PRODUCIBLE? (3B.7)

- HOW SURVIVABLE IS MIFASS? (3B.8)

- HOW MUCH WILL MIFASS COST? (3B.9)

LS-15-29

(U) The equipment suite developed for MIFASS operational testing is called the Engineering Developmental Model (EDM). Five phases of developmental testing were completed by 4Q FY 86. These included MILSPEC environmental testing for each of the hardware components, laboratory testing of the integrated system, and developmental field testing at Camp Pendleton, California, which used a variety of communications media including communications security (COMSEC) devices. Formal operational testing has begun at Twentynine Palms, California, and is expected to last for 6 months. Test results are expected in 3Q FY 87. Prior to the IOC (1Q FY 93), upgrades will be made to the Microcomputer and the Mass Memory. In addition, at least 60,000 to 70,000 lines of CMS-2 software will be added for

- Performing Unit-Level Message Switch (ULMS) functions within MIFASS and handling reduced data rates.

- Incorporating a modified point mass algorithm in technical fire control.

- Supporting the current organization and doctrine for Marine Amphibious Force operations.

- Supporting interfaces to the Battery Computer System (BCS), Meteorological Data System (MDS), and Firefinder. A TADIL B interface to the TAOM is planned but not included in the estimate of 60,000 to 70,000 LOC.

(U) Hardware modifications include adding three new boards to the Microprocessor: single-card processor (SCP), memory control module with memory (MCMM), and 1-megaword (2 MB) semiconductor memory module (SMM). All are currently in production. The Mass Memory will be upgraded with 64-kilobit CMOS static RAM modules which will increase memory by a factor of four to 4 million words (8 MB). Another hardware modification is the militarization of the MIFASS PLRS Interface Controller (MPIC).

(U) Preproduction engineering is planned for FY 87 to FY 89; the production contract will be awarded in 1Q FY 90 (a schedule is provided in Appendix F). For preproduction engineering, $2.4 million[1] in RDT&E and $4.1 million in procurement funds are allocated for hardware. For software, $22.3 million is programmed in RDT&E and $27.1 million in procurement funds. The modifications planned for the MIFASS hardware appear to be minimal and of low technical risk. The software changes are a significant portion (about 40 percent) of the EDM software (158,000 lines of code), not including software for the TADIL B interface. Development of the EDM hardware is nearly complete, and this hardware could be fielded in nearly its current form.

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[1](U) Costs cited here are in constant FY 87 dollars.

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OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.1 SUMMARY OF MIFASS STATUS

- ## SYSTEM
  - EDM: IN OPERATIONAL TESTING (OT II)
  - IOC: ADDS INTERFACES AND OTHER SOFTWARE; UPGRADES MC, MM

- ## SOFTWARE - IOC
  - AT LEAST 60,000-70,000 ADDITIONAL LOC (CMS-2) TO 158,000 IN EDM; \$49 Mª PROGRAMMED
  - 36 MONTHS SCHEDULED TO START 1Q FY 87 (PENDING RELEASE OF FUNDS)

- ## HARDWARE
  - EDM
    - -- MAB (Minus) Slice
    - -- MILSPEC Tested/Analyzed Except MIFASS PLRS Interface Controller
  - IOC
    - -- Modifications Defined; \$6.5 Mª Programmed for Preproduction Engineering Pending Release of Funds
    - -- Production Contract Award 1Q FY 90[b]

[a]CONSTANT FY 87 DOLLARS.
[b]AN FY 89 START HAS BEEN PROPOSED BY THE MARINE CORPS, WHICH WOULD LEAD TO AN IOC IN 1Q FY 92.

CONCLUSION: MIFASS IS A MATURE SYSTEM WITH NEARLY FIELDABLE EDM HARD-WARE. SIGNIFICANT SOFTWARE CHANGES ARE IN THE PROGRAM PLAN. IOC PLANNED FOR FY 93.

UNCLASSIFIED

E-5

LS-16-10

(U) MIFASS is being developed using the traditional approach to military systems in effect at the time MIFASS was started: defining and developing the hardware early, building the hardware and developing the software to unique system specifications, and requiring all components to meet full military specifications. MIFASS is thereby custom engineered and MILSPEC throughout.

(U) MIFASS uses CMS-2, a Navy standard computer programming language that predates initiatives to develop new systems in Ada. Since hardware was defined and selected early, the hardware features were used as constraints on the software design. This approach allowed the developer to take advantage of unique characteristics of the hardware environment for the software and to tailor the software design to the hardware architecture. An example is the extent to which MIFASS software is tailored to the special capabilities of the Dynamic Situation Display device, including features to expedite screen management of the graphics and display areas. This approach to systems design has led to custom design throughout the software.

(U) The traditional approach used in MIFASS may lead to several types of traditional problems:

- Very long procurements leading to either fielding obsolete technology or canceling a program because the requirements change so drastically in the interval between initial specification and planned fielding. For MIFASS, the 1979 technology and hardware architecture decisions have led to a much larger and heavier system than could be fielded in 1993 with current technology.

  Environmental requirements specified as MILSPEC throughout.

- After the system is fielded, spare parts become increasingly difficult to obtain during the life of the system because the technology is so old.

- The software quickly becomes very difficult to maintain because the programming language used does not enforce the kind of development practices that enhance maintainability and because the software design is so closely tied to meeting the stated system requirement.

- The software is not portable because there is no enforcement mechanism to ensure that the compilers for different computers (e.g., CMS-2) meet the same specifications—DoD's Ada effort is the first for any language to combat this problem.

- The software is not shareable with any other program and cannot make use of software developed for any other program because the operating system and other support software are unique to the system they support.

E-6

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.2 HOW MODERN A SYSTEM WILL MIFASS APPROACH PROVIDE?

- **HARDWARE APPROACH IS THE TRADITIONAL ONE**
  - HARDWARE SELECTED BEFORE SOFTWARE DEVELOPED
  - CUSTOM ENGINEERING THROUGHOUT
  - MILSPEC THROUGHOUT

- **SOFTWARE APPROACH IS THE TRADITIONAL ONE**
  - NAVY STANDARD LANGUAGE IN 1979 (PRE-Ada)
  - ALL CUSTOM DESIGNED
  - DESIGNED EXCLUSIVELY TO MEET MIFASS SPECS

- **RESULTS OF TRADITIONAL APPROACH ARE TRADITIONAL PROBLEMS**
  - 1979 TECHNOLOGY TO BE FIELDED STARTING IN FY 93 WILL PROVIDE LARGER AND HEAVIER SYSTEM THAN CURRENT TECHNOLOGY
  - OVER 20-YEAR LIFE, SPARE PARTS MAY BE EXPECTED TO BE A PROBLEM

E-7

LS-17-33

(U)   Measuring MIFASS against the recommendations for system development contained in a recent IDA study,[1] it can be seen that MIFASS does use a modular approach and partially satisfies using a common hardware approach (the microprocessor, AN/AKY-14, is a standard Navy product) and using commercially developed products (e.g., the Type 1 and Type 2 printers). The degree to which the militarization requirements were reexamined for MIFASS is unknown.

(U)   In comparison, the plan for developing the Tactical Combat Operations system, which is to be fielded in 1990, meets all the applicable recommendations, including using Ada for application-unique software, developing and testing software early on surrogate computers (End User Computer Equipment), and delaying selection of hardware as long as possible.

E-8

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[1](U) *An Independent Review of the Army Tactical Command and Control System*, IDA Memorandum Report M-107, August 1985, UNCLASSIFIED.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.2 HOW MODERN A SYSTEM WILL MIFASS APPROACH PROVIDE? (CONT'D)

SOME RECOMMENDATIONS FROM 1985 STUDY, "AN INDEPENDENT REVIEW OF THE ARMY TACTICAL COMMAND AND CONTROL SYSTEMS"	MIFASS (IOC 1993)	TCO (IOC 1990)
USE ADA FOR APPLICATION-UNIQUE SOFTWARE	NO	YES
USE MODULAR APPROACH TO SOFTWARE DEVELOPMENT	YES	YES
DEVELOP AND TEST SOFTWARE ON SURROGATE COMPUTERS	NO	YES
EXPLOIT COMMON HARDWARE APPROACH	PARTIALLY	YES
REEXAMINE MILITARIZATION SPECIFICATIONS TO ENSURE THEY ARE REQUIRED	UNKNOWN	YES
DELAY SELECTION OF HARDWARE AS LONG AS POSSIBLE	NO	YES
TAKE FULL ADVANTAGE OF COMMERCIALLY DEVELOPED PRODUCTS	PARTIALLY	YES

CONCLUSION: MIFASS IS FOLLOWING THE TRADITIONAL SYSTEM DEVELOPMENT APPROACH, WHICH IS NOT LIKELY TO LEAD TO THE FIELDING OF A MODERN SYSTEM.

E-9

(U) Table 3B.3 contrasts the major Marine Corps functional requirements with the capabilities provided by MIFASS in the production baseline system to be fielded at IOC. The table indicates that, by IOC, MIFASS will support most major Marine Corps required functions, with the possible exception of those associated with survey support and embedded training.[1]

(U) Review of the functions to be included indicates that MIFASS should provide the Marine Corps with a significant improvement over the current manual capability for command, control, coordination, and integration of fire support from artillery, mortars, naval gunfire, and air 'ets. The final determination of how well MIFASS will meet the requirements must, of course, await results of the operational tes.s now in progress. However, the Marine Corps/contractor efforts to date in system design and development testing indicate that the functional capabilities of MIFASS will satisfy most of the stated Marine Corps requirements.[2]

(U) Two functional requirements that will not be met by MIFASS at IOC are survey support and embedded training. In the original EDM program, survey support was to be provided by a separate Fire Direction/Survey Calculator, which will not be fielded initially in MIFASS. For the embedded training requirement, the addition of "Simulation and Training Software with Automatic Scenario Generation" is planned as a part of a post-IOC P3I program. Plans also include the addition of decision aids to enhance the fire support planning and fire plan execution processes.

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[1](U) A more detailed breakdown of the functional tasks and the degree to which each system supports them can be found in Appendix A.

[2](U) A detailed description of the Marine Corps functional requirements can be found in the MIFASS EDM *Contract Specification*, ELEX-M-296E, dated January 1982 and amended in May 1983, UNCLASSIFIED, and the *Top Level Requirements Document (TLRD) for Implementation in Current Organization and Procedures*, dated 11 February 1984, UNCLASSIFIED. The original contract specification required fire support planning and attack system analysis for nuclear and chemical, as well as conventional, weapons. This requirement was deleted in the May 1983 amendment.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.3 MAJOR MARINE CORPS FIRE SUPPORT FUNCTIONAL REQUIREMENTS vs MIFASS CAPABILITIES

FUNCTIONS	REQUIRED BY MC	MIFASS IOC
FS CONTROL & COORDINATION		
Perform FS Planning (All Assets)	CONV[1]	YES
Attack System Analysis	CONV[1]	YES
TUBE/AIR CONFLICT PROCESSING	YES	YES
TARGET PROCESSING	YES	YES
AIR SUPPORT PROCESSING		
Perform Air Support Processing	YES	YES
Generate Coordinated Air Plans	YES	YES
Perform Helicopter Control	YES	YES
Provide Aircraft Direction	YES	YES
Flight Path Profiling	YES	YES
FA & MORTAR TACTICAL OPERATIONS		
Fire Support Planning	CONV[1]	YES
Attack System Analysis	CONV[1]	YES
Prepare Fire Orders	YES	YES
Support Met and Survey	YES	PARTIAL[2]
Status Reporting	YES	YES
POSITION LOCATION INFORMATION PROCESSING	YES	YES
AMMUNITION STATUS AND CONTROL	YES	YES
TECHNICAL FIRE DIRECTION	YES	YES
SUPPORT OF OBSERVER OPERATIONS	YES	YES
FORWARD AREA AIR DEFENSE	YES	YES
EMBEDDED TRAINING	YES	NO[3]

1. Conventional only; nuclear and chemical functions were requirements in the original MIFASS ROC and System Specification but they have been deleted from Production Baseline Specification.
2. Survey support will be performed by separate Fire Direction/Survey Computer, not currently planned to be initially fielded in MIFASS.
3. Planned to be implemented after IOC.

CONCLUSION: BY IOC MIFASS WILL SUPPORT MOST MAJOR MARINE CORPS REQUIRED FUNCTIONS, WITH THE POSSIBLE EXCEPTION OF THOSE ASSOCIATED WITH SURVEY CALCULATIONS AND EMBEDDED TRAINING.

(U)   Table 3B.4 identifies the interfaces required by the Marine Corps for an advanced fire support system.   Each of the interfaces listed in the first column of the chart is specified in the MIFASS System Specification[1] with two exceptions.   The Tactical Air Operations Module (TAOM) interface was deleted for EDM, but the Marine Corps intends to implement the TAOM interface by IOC.   The NATO interfaces were not addressed in the System Specification, but the Marine Corps plans to implement these interfaces through an interface with the forthcoming Army system.

(U)   Three of the required interfaces are provided in the EDM software: Position Location Reporting System (PLRS). Digital Communications Terminal (DCT), and the MIFASS-to-MIFASS interfaces.   The protocols and messages in the DCT software for the Marine Corps differ from the protocols and messages planned to be used by the Army.

(U)   Not all the Marine Corps required interfaces will be implemented in MIFASS by IOC (FY 92-93).   The interfaces for the Tactical Combat Operations (TCO) system have not yet been defined, and the degree to which this interface must be supported is still to be determined.   The MIFASS interface for NATO is to be resolved when interfaces with the Army are resolved.   Interface to the Naval Tactical Data System (NTDS) will not be implemented by MIFASS IOC.

(U)   The Marine Corps currently plans to implement the TACFIRE protocol and message sets for BCS, Firefinder, and MDS by IOC.   If the Army does not field AFATDS by MIFASS IOC, the Marine Corps would plan to implement additional TACFIRE messages.

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[1](U) Naval Electronics Systems Command, *Contract Specification--Marine Integrated Fire and Air Support System Engineering Development Model (EDM)*, ELEX-M-296E, 15 January 1982, with change pages dated 25 May 1983, UNCLASSIFIED.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.4 INTERFACES - MIFASS REQUIREMENTS vs CAPABILITIES

MIFASS INTERFACE REQUIREMENTS	IN MIFASS EDM	IN MIFASS AT IOC
POSITION LOCATION REPORTING SYSTEM (PLRS)	YES	YES
BATTERY COMPUTER SYSTEM (BCS)	NO	YES
DIGITAL COMMUNICATION TERMINAL (DCT)	YES[1]	YES[1]
TACTICAL AIR OPERATIONS MODULE (TAOM)	NO	YES
TACTICAL COMBAT OPERATIONS (TCO)	NO	NO
MARINE INTEGRATED FIRE & AIR SUPPORT SYSTEM (MIFASS)	YES	YES
NATO ALLIES	NO	NO
NAVAL TACTICAL DATA SYSTEM (NTDS)	NO	NO
FIREFINDER	NO	YES
MET DATA SYSTEM (MDS)	NO	YES
TACFIRE	NO	PARTIALLY[2]

[1] ARMY AND MARINE CORPS DCTs USE DIFFERENT PROTOCOLS AND MESSAGE STANDARDS.
[2] BCS, MSD, AND FIREFINDER ALL USE THE TACFIRE PROTOCOL AND EACH UTILIZES A SUBSET OF THE TACFIRE MESSAGE SET.

E-13

LS-16-6

(U)   The next two tables address the weight of the MIFASS equipment.   Table 3B.5a1 shows the weight of MIFASS equipment at each of the seven types of operating centers for the Marine Corps: Marine Air-Ground Task Force (MAGTF) Headquarters Supporting Arms Special Staff (MHSASS), Division (Div) Fire Support Coordination Center (FSCC), Regiment (Regt) FSCC, Bn FSCC, Regt rDC, Bn FDC, and the Separate DASC.   A MAF nominally includes 21 centers: 1 MHSASS, 1 Div FSCC, 3 Regt FSCCs, 9 Bn FSCCs, 1 Regt FDC, 5 Bn FDCs, and 1 Separate DASC.   For the total force (roughly 5 MAFs) there are 4 MHSASSs, 4 Div FSCCs, 13 Regt FSCCs, 39 Bn FSCCs, 5 Regt FDCs, 22 Bn FDCs, and 5 Separate DASCs.   In addition, four training and supports sets are to be procured for the total force, one each to Marine Corps Communications-Electronics School (MCCES) and Marine Corps Tactical Systems Support Activity (MCTSSA) and two to the Marine Corps Logistics Base (MCLB).

(U)   Equipment components, excluding panels, COMSEC devices, cables, and shelters, are designated "boxes" in the table.   Although the DSD consists of two units, it is counted as a single box in this analysis.   Every MIFASS center can be operated unsheltered using a special set of cables identified in the third column (Cables) of the chart.   Cable weights are for data and power, exclusive of communications cables.   Center weight (fourth column) is the sum of the equipment and cable weights. Centers range from nearly 1,900 lb to over 5,000 lb.   In a MAF there are 21 centers with an average unsheltered weight of 2,600 lb. Equipment for the Battalion FDC weighs 2,910 lb.

(U)   The last three columns in the chart describe the incremental and total weights of centers that include the Small Shelter Units (SSUs, each 8 ft by 8 ft by 10 ft) and the dedicated SSU cables.   The data are based on the current planning assumptions of 2,398 lb for the SSU and 394 lb for the SSU cables.   The Bn FSCC is planned to be operated without shelters.   When shelters and shelter cables are added to the equipment and cables for unsheltered operations, the weight of MIFASS for a MAF is more than doubled, and the average weight of the 21 centers in a MAF is 5,800 lb.

(U)   Of the 250,400 lb of equipment for unsheltered operations in the total force, 75 percent or 187,370 lb represents equipment and 25 percent is cables.   When the weights of the dedicated shelters and cables for these shelters are included, 33 percent of the weight is equipment, 19 percent is cables, and 48 percent is SSUs.   Ninety percent of the cable weight is for power cables.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.5a1 WEIGHT OF MIFASS CENTERS

	NMBR BOXES	WITHOUT SMALL SHELTERS			INCLUDING EQUIPMENT FOR SHELTERIZED OPERATIONS		
		WEIGHT BOXES (LB)	WEIGHT CABLES (LB)	CENTER WEIGHT (LB)	SSU WEIGHT (LB)	SSU CABLES (LB)	TOTAL WEIGHT (LB)[a]
MHSASS	24	1,218	672	1,890	2,398	394	4,682
DIV FSCC	54	2,815	835	3,650	4,796	788	9,234
REGT FSCC	45	2,293	657	2,950	4,796	788	8,534
BN FSCC	31	1,401	629	2,030	--	--	2,030
REGT FDC	41	2,207	623	2,830	4,796	788	8,414
BN FDC	39	2,051	859	2,910	4,796	788	8,494
SEP DASC	84	4,251	779	5,030	7,194	1,182	13,406
MAF SUBTOTAL	812	40,164	14,836	55,000	57,552	9,456	122,008
TOTAL USMC	3,772	187,370	63,030	250,400	268,580	44,130	563,110

[a]Includes SSUs, SSU cables, boxes, and cables for unsheltered operations.

OBSERVATION: MIFASS EQUIPMENT ("BOXES," NOT INCLUDING CABLES AND SHELTERS) IS 75 PERCENT OF TOTAL WEIGHT EXCLUSIVE OF SHELTERS (187,370/250,400) AND 33 PERCENT OF TOTAL WEIGHT WHEN SHELTERS ARE INCLUDED (187,370/563,110).

BW (11-10) 1

(U) Table 3B.5a2 describes the weight of the MIFASS components. The component weights are measured values for the EDM equipment, as used in the ongoing Operational Test by the Marine Corps, with two exceptions. The weight of the SSU with racks and special panels is an estimate for a typical SSU provided by the contractor. To maintain consistency with MIFASS program definitions, a cable set as used here is one half of the total cables used by two strings, either for an SSU or for unsheltered operations.

(U) The largest "box" is the DSD, weighing nearly 124 lb. When closed up for relocation, the DSD consists of two elements, one weighing 70 lb and the other weighing 54 lb. All the other components are transported as single units. There are no transit cases for transportability--caps protect connectors and covers protect displays and keys. Caps and covers are included in these weights.

(U) The total weights in this chart do not include the weights of SSUs nor SSU cables. Thus, the 63,000 lb for cables (25 percent of the total weight) are those for unsheltered operations. As in previous charts, cables shown are exclusive of communications cables. Of the "boxes," the weight drivers are the Dynamic Situation Displays (16.8 percent of the total weight) and Battery Boxes (26.2 percent of the total weight).

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.5a2 WEIGHT OF MIFASS COMPONENTS

	NUMBER PROCURED	UNIT WEIGHT (LB)	MIFASS WEIGHT SUBTOTAL (KLB)	% OF TOTAL
DSD - DYNAMIC SITUATION DISPLAY	339	123.9	42.0	16.8
CCP - COMMUNICATION CONTROL PANEL	459	29.0	13.3	5.3
T1P - TYPE 1 (SLOW) PRINTER	370	17.0	6.3	2.5
T2P - TYPE 2 (FAST) PRINTER	114	42.6	4.9	1.9
MC - MICROCOMPUTER	252	54.3	13.7	5.5
MM - MASS MEMORY	247	42.0	10.4	4.2
MSD - MASS STORAGE DEVICE	60	28.4	1.7	0.7
PM - POWER MODULE	205	51.8	10.6	4.2
BB - BATTERY BOX	1,151	57.0	65.6	26.2
DCE - DIGITAL COMM EQUIPMENT	195	58.0	11.3	4.5
SC - STAR COUPLER	380	20.0	7.6	3.0
SSU - SMALL SHELTER UNIT	112	2,398[a]	-[e]	-
CABLE SET	248	315[b,c]	63.0[e]	25.2
TOTAL	4,132[d]		250.4[e]	100.0

[a] For reference only; weights used in accompanying charts are for equipment only and do not include the weight of shelter.
[b] Value cited is for Battalion FSCC (unsheltered); values for other centers (unsheltered) are 312 (Regt FDC), 329 (Regt FSCC), 336 (MHSASS), 390 (DASC), 418 (Div FSCC), and 430 (Bn FDC). SSU cable sets are 394 lbs each. Centers require 2 SSUs when sheltered and 2 additional cable sets for unshelterized operations.
[c] A cable set is approximately 8-12% data and 88-92% power distribution.
[d] 3,772 "boxes" plus 112 small shelter units and 248 cable sets.
[e] Totals do not include weight of shelters or cables used only for shelters.

CONCLUSION: CABLES AND BATTERIES ARE THE PRIMARY WEIGHT DRIVERS FOR MIFASS.

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E-17

(U) Table 3B.5b summarizes the environmental requirements for MIFASS. These requirements are typically MILSPEC with tests performed in accordance with MIL-E-16400. Particularly severe are

- Operating and storage temperatures, with additional heat from solar radiation
- Protection from condensation (and other) effects within the humidity range
- Immersion of component in transportable, closed up configuration after inducing a severe temperature gradient
- Dust and blowing sand
- Vibration and shock, including 2-ft drop test on corners and faces
- Lightning and EMP protection for operating equipment.

(U) Some waivers to the environmental requirements were approved for certain components for the EDM and may be continued for the production equipment.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.5b MIFASS ENVIRONMENTAL REQUIREMENTS

	MIFASS REQUIREMENTS
ALTITUDE -- OPERATING -- TRANSIT	15,000 FT 25,000 FT
TEMPERATURE -- OPERATING -- STORAGE	-18 TO 125 °F -80 TO 160 °F
SOLAR RADIATION	355 BTU/HR/FT (1,119 W/M^2)
HUMIDITY	TO 95% RH WITH WATER OR FROST CONDENSATION
SALT FOG	OPERATES AFTER MIL-E-16400 TEST
RAIN	2 IN/HR FOR NONOPERATING SHELTERS, WATER SPILL ON OPERATING KEYBOARDS AND CONTROL PANELS
IMMERSION	HEAT TO 113° F, IMMERSE IN 3 FT WATER, 2 HOURS (NONOPERATING)
SAND & DUST	OPERATES IN DUST & BLOWING SAND ENVIRONMENT
VIBRATION (MODE)	MILITARY TACTICAL VEHICLES & AIRCRAFT (LOOSE OR MOUNTED)
SHOCK	2-FT DROP TEST ON FACES AND CORNERS
ORIENTATION	NO STATED REQUIREMENT
LIGHTNING	WITHSTANDS TRANSIENTS FROM NEARBY STRIKES
EMP	MILSTD FOR OPERATING EQUIPMENT
TEMPEST	NACSEM 5100; 100 M GUARDED RADIUS
SECURE LIGHTING	NO STATED REQUIREMENT

BW (10-28) 4

(U) Table 3B.6a examines commonality requirements for the planned Marine Corps systems. Seven systems, including MIFASS, are identified in the current Marine Corps Command and Control Master Plan.[1] The Master Plan does not define common hardware or software requirements among these systems. Further, none of the other six programs have specific plans to use either the MIFASS hardware or the software. However, the TCO system has a requirement to use non-developmental items (NDI), and MIFASS, already developed, is an NDI candidate. The next chart shows that TCO and MIFASS have little potential for commonality. Thus, it appears that MIFASS has little commonality with any of the other MTACCS systems.

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[1](U) HQ USMC, U.S. Marine Corps Command and Control Master Plan, March 1983, UNCLASSIFIED.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.6a TO WHAT DEGREE WILL MIFASS HAVE COMMONALITY WITH OTHER MARINE CORPS SYSTEMS?

- MARINE CORPS TACTICAL COMMAND AND CONTROL SYSTEM

  (MTACCS) CONSISTS OF SEVEN SYSTEMS[1]:

  - MARINE INTEGRATED FIRE AND AIR SUPPORT SYSTEM (MIFASS)
  - TACTICAL COMBAT OPERATIONS SYSTEM (TCO)
  - TACTICAL AIR OPERATIONS MODULE (TAOM)
  - MARINE AIR-GROUND INTELLIGENCE SYSTEM (MAGIS)
  - POSITION LOCATION REPORTING SYSTEM (PLRS)
  - MARINE INTEGRATED PERSONNEL SYSTEM (MIPS)
  - TACTICAL WARFARE SIMULATION EVALUATION AND ANALYSIS SYSTEM (TWSEAS)

- MIFASS HARDWARE AND SOFTWARE IS NOT CURRENTLY PLANNED

  FOR USE IN ANY OTHER MTACCS PROGRAM. HOWEVER, IT IS STILL

  AN NDI CANDIDATE FOR TCO

[1] U.S. MARINE CORPS COMMAND AND CONTROL MASTER PLAN, MARCH 1983.

CONCLUSION: MIFASS HAS LITTLE COMMONALITY WITH OTHER

MARINE CORPS TACTICAL COMMAND AND CONTROL

SYSTEMS.

E-21

BW (10-29) 1

(U)   As mentioned earlier, the MTACCS TCO system, while not yet developed, has an IOC earlier than MIFASS. According to the draft ROC provided by the Marine Corps,[1] the TCO system is planned to achieve IOC in 1990.

(U)   Table 3B.6b compares three TCO requirements with MIFASS equipment characteristics:

• There is a factor of 17 between the TCO workstation requirement (30 lb) and the smallest MIFASS configuration that supports a workstation (510 lb).

• Equipment at MIFASS centers will be very difficult to transport in a backpack mode. Indeed, there are 31 boxes weighing a total of 1,400 lb in a maneuver Bn FSCC. The largest component (DSD at 124 lb) consists of two units, the largest weighing 70 lb. In addition, the cables for unsheltered operations for Bn FSCC weigh 630 lb.

• Both systems require unsheltered operations.

(U)   The weight of MIFASS components makes it very unlikely that MIFASS equipment will be compatible with the TCO system as defined in the current statement of the TCO Required Operational Capability.

E-22

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[1](U) HQ USMC, *Proposed Draft Required Operational Capability (ROC) for the Tactical Combat Operations (TCO) System*, April 1986, UNCLASSIFIED.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.6b TO WHAT DEGREE IS MIFASS EQUIPMENT COMPATIBLE WITH TCO ROC*?

TCO REQUIREMENTS (IOC 1990)

DUTY (WORK) STATION MUST BE MAN-PORTABLE AND PREFERABLY WEIGH NO MORE THAN 30 LB

ANY EQUIPMENT COMPONENTS INTENDED FOR USE BY MANEUVER ELEMENTS AT OR BELOW BATTALION LEVEL MUST BE CAPABLE OF BEING TRANSPORTED IN A BACK-PACK OR HAND-HELD MODE

OPERATE UNSHELTERED. OPERATE CONTINUOUSLY DURING ALL PHASES OF AMPHIBIOUS OPERATIONS AND SUBSE-QUENT OPERATIONS ASHORE

MIFASS CHARACTERISTICS (IOC 1993)

MINIMUM EQUIPMENT TO SUPPORT A WORK-STATION (DSD, MC, MM, PM, DCE, SC, 1/2 CABLE SET) WEIGHS 510 LB

MIFASS EQUIPMENT PLANNED FOR THE Bn FSCC CONSISTS OF 31 BOXES, WHICH RANGE IN WEIGHT FROM 17 TO 124 LB. THEIR TOTAL WEIGHT IS 1,400 LB. AN ADDITIONAL 630 LB OF CABLES IS RE-QUIRED. UNSHELTERED CENTER TOTAL WEIGHT IS 2,030 LB

OPERATE IN ALL WEATHER CONDITIONS WITH NO GENERAL REQUIREMENT FOR SHELTERS. . ., EXCEPT AS REQUIRED FOR PERSONAL COMFORT

*PROPOSED REVISED ROC FOR THE TCO SYSTEM, APRIL 1986.

E-23

LS-17-26

(U) Table 3B.7 addresses risks for producing the MIFASS hardware. The EDM hardware has already been fabricated and tested to all the Marine Corps requirements. Only a few hardware changes are planned for the EDM hardware to achieve the production system, and these consist primarily in upgrading memory boards in the Mass Memory and using three new boards in the Microcomputer. The piece parts and new boards required for these upgrades are already in production. Therefore, the risks associated with the production of MIFASS appear to be minimal.

(U) One key component associated with supporting the PLRS interface to MIFASS is the MIFASS PLRS Interface Controller (MPIC). This equipment, while not a part of the MIFASS program, is still in brassboard configuration. RDT&E funds ($100,000) have been allocated to militarizing the MPIC before MIFASS production begins.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.7 TO WHAT DEGREE IS MIFASS PRODUCIBLE?

- NEARLY A MAB's WORTH OF MIFASS HARDWARE WAS PRODUCED FOR EDM. ALL BOXES PASSED THE SAME TESTS THAT WILL BE REQUIRED OF THE PRODUCTION HARDWARE. FEW CHANGES ARE EXPECTED IN THE EDM HARDWARE BEFORE PRODUCTION

- ALL COMPONENTS EXPECTED TO BE USED IN IOC HARDWARE ARE CURRENTLY IN PRODUCTION, INCLUDING

  - SINGLE CARD PROCESSOR (SCP)
  - MEMORY CONTROL MODULE WITH MEMORY (MCMM)
  - 1-M WORD SEMICONDUCTOR MEMORY MODULE (SMM)

- THE MIFASS PLRS INTERFACE CONTROLLER (MPIC) IS IN BRASS-BOARD CONFIGURATION AND NOT YET PART OF THE MIFASS PROGRAM

CONCLUSION: RISKS ASSOCIATED WITH PRODUCTION OF MIFASS HARDWARE WOULD APPEAR TO BE MINIMAL.

E-25

LS-16-12

(U)   The MIFASS hardware architecture has a requirement for a significant number of components to be operating in order to carry out minimal functions of a center. This chart identifies the requirement and relates it to survivability.

(U)   Survivability of MIFASS is achieved in two primary ways. The first is using two strings of equipment and echeloning one string to a new location while the remaining string continues to support center operations. The second technique is backing up all the data bases for each center at another center, so that the functions of a center could be reestablished even when both strings in a center are nonfunctional. Echeloning and functional backup capability are key to maneuverability and survivability for Marine Corps operations.

(U)   Using two strings to support echeloning is a major driver for the hardware architecture in weight and cost, since most equipment (as well as cables) is duplicated in each center.

(U)   Each string, however, has a number of components each of which must be operational for the string to function. These components are the DSD, MC, MM, PM, Star Coupler, and DCE. In the Bn FDC, Bn FSCC, and Regt FDC, each string has only one each of the MC, MM, PM, and DCE. Therefore, the loss of any one of these components at these centers (70 percent of all centers in a nominal MAF) denies that center the capability of echeloning.

(U)   Loss of echeloning for a center means that another center must take on additional functions while the other center moves to a new location. To the extent that all the required functions cannot be taken over, that processing is degraded, or that maneuverability of centers is inhibited, survivability is reduced.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.8 SURVIVABILITY

- A CENTER CANNOT OPERATE WITHOUT ONE EACH OF THE FOL-LOWING COMPONENTS - DSD, MC, MM, PM, STAR COUPLER, DCE

- MORE THAN 70 PERCENT OF THE CENTERS IN A MAF (E.G., Bn FDC) HAVE ONLY 2 EACH OF MC, MM, PM, AND DCE

- ECHELONING REQUIRES TWO COMPLETE SETS OF THESE CRITICAL COMPONENTS

- ECHELONING AND FUNCTIONAL BACKUP CAPABILITY AMONG CENTERS ARE KEY TO MANEUVERABILITY AND SURVIVABILITY FOR MARINE CORPS

CONCLUSION: LOSS OF ANY CRITICAL COMPONENT (MC, MM, PM, OR DCE) REDUCES SURVIVABILITY OF A CENTER.

E-27

LS-12-24

(U)   Table 3B.9a provides data on two estimates of MIFASS hardware costs. The first estimate, entitled "Current Program," is based on the unit costs used by the Marine Corps in developing their latest Program Objective Memorandum (POM) estimate and in data presented in the 7 October 1986 briefing to OSD. The second estimate is based on the most recent (1984) life cycle cost (LCC) study for MIFASS.[1] The relation between the unit costs for these two estimates is given in the last column: the Unit Cost Factor is the ratio of the unit cost for the current program to the unit cost from the LCC study. Rationale for these differences were not available from the Marine Corps.

(U)   Using the two estimates, the total hardware costs[2] for MIFASS are $196.1 million and $228.8 million. The cost drivers are, in order of their fraction of the total current program, MCs, DCEs, MMs, and DSDs. Together, these components are nearly 60 percent of the equipment costs.

(U)   Using the two cost estimates as upper and lower bounds, the costs of MIFASS centers are as follows: MHSASS, $1.28-1.58 million; Div FSCC, $2.87-3.44 million; Regt FSCC, $2.69-3.24 million; Bn FSCC, $1.47-1.55 million; Regt FDC, $2.25-2.74 million; Bn FDC, $1.98-2.45 million; and Separate DASC, $4.42-5.30 million. A nominal MAF costs about $42 to $49 million. (See Table 2.7.)

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[1](U) Noruen Systems, *Life Cycle Cost/Design to Unit Production Cost (LCC/DTUPC)*, 15 June 1984, UNCLASSIFIED.

[2](U) All costs cited here are in constant FY 87 dollars.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.9a COST OF MIFASS COMPONENTS[a]

	NUMBER PROCURED	CURRENT PROGRAM[b]			PRIOR ESTIMATES[c]			UNIT COST FACTOR
		UNIT COST ($ K)	SUBTOTAL ($M)	% OF TOTAL	UNIT COST ($ K)	SUBTOTAL ($M)	% OF TOTAL	
DSD	339	77.2	26.2	13.4	90.3	30.6	13.4	0.85
CCP	459	39.6	18.2	9.3	42.3	19.4	8.5	0.94
T1P	370	16.3	6.0	3.1	14.6	5.4	2.4	1.12
T2P	114	29.3	3.3	1.7	29.7	3.4	1.5	0.99
MC	252	137.3	34.6	17.6	205.2	51.7	22.6	0.67
MM	247	109.1	27.0	13.7	82.7	20.4	8.9	1.32
MSD	60	41.3	2.5	1.3	52.0	3.1	1.4	0.79
PM	205	29.2	6.1	3.1	30.6	6.3	2.7	0.98
BB	1,151	4.1	4.7	2.4	4.6	5.3	2.3	0.89
DCE	195	139.4	27.2	13.9	135.6	26.5	11.6	1.03
SC	380	13.3	5.1	2.6	4.9	1.9	0.8	2.71
SSU	112	138.7	15.5	7.9	313.4	35.1	15.3	0.44
CABLE SET	248	79.6	19.7	10.0	79.6	19.7	8.6	N/A
TOTAL	4,132[d]		196.1	100.0		228.8	100.0	

a. All costs are in constant FY 87 dollars.
b. Based on detailed data provided to IDA 16-31 Oct. 86.
c. Based on Life Cycle Cost/Design to Unit Product Cost (LCC/DTUPC), Norden Systems, 15 Jun 85; cable costs are those provided for current program.
d. 3,772 "boxes" plus 112 small shelter units and 248 cable sets.

CONCLUSION: MCs, DCEs, MMs, AND DSDs ARE PRIMARY COST DRIVERS FOR MIFASS.

E-29

LS-19-29

(U) Table 3B.9b shows the current estimates of total research and development costs and procurement costs for the MIFASS program. (Alternative estimates from the 1984 life cycle cost study discussed in Table 3B.9a are not shown in this chart.) Both constant FY 87 dollars and then-year dollar estimates are shown. Highlighted at the bottom right of the chart are the costs used by the Marine Corps in the 7 October 1986 briefing to OSD.

(U) Hardware at $196.1 million represents 44 percent of the $446 million [1] MIFASS program. In addition, there is $71.3 million (16 percent) allocated for installation kits, tests, integration, and other recurring costs. Nonrecurring costs are $106.9 million (24 percent of the total program). These include $27.1 million for software upgrade and modifications (details are dependent on the work completed in the preproduction phase and are not known at this time). The current estimate of $42.2 million for integrated logistics support (ILS) and documentation is under review and new estimates are reported to be revised downward. Initial spares are $7.7 million (2 percent). Fee is identified separately at $27.7 million (6 percent of total program).

(U) For FY 87 to FY 91, a total of $36.3 million is programmed for RDT&E. Of this, $22.3 million is allocated to software (primarily interfaces) and $2.4 million to hardware. The total RDT&E and procurement funding for additional software and modifications is $49.4 million; for hardware modifications, it is $6.5 million.

E-30

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[1](U) All costs cited here are in constant FY 87 dollars.

OPTION 3B - MARINE CORPS FIELDS MIFASS
TABLE 3B.9b COST OF MIFASS PROGRAM

	NUMBER	UNIT COST FY 87 ($K)	COMPONENT SUBTOTAL (FY 87 $M)	PROGRAM COST CONSTANT (FY 87 $M)	FY 89 START (THEN-YEAR $M)
HARDWARE RECURRING				196.1 (44%)	229.4
DSD	339	77.2	26.2		
CCP	459	39.6	18.2		
T1P	370	16.3	6.0		
T2P	114	29.3	3.3		
MC	252	137.3	34.6		
MM	247	109.1	27.0		
MSD	60	41.3	2.5		
PM	205	29.9	6.1		
BB	1,151	4.1	4.7		
DCE	195	139.4	27.2		
SC	380	13.3	5.1		
SSU	112	138.7	15.5		
Cable Set	248	79.6	19.7		
OTHER RECURRING				71.3 (16%)	82.1
Tests (Centers, MABs, MIFASS-PLRS)			8.0		
Integration and Installation Kits			35.3		
Management Reserve			28.0		
NONRECURRING				106.9 (24%)	118.5
Initial Tests and Verification, Test Equip.			23.5		
ILS and Documentation[a]			42.2		
Software Upgrade and Modifications			27.1		
Hardware Redesign			4.1		
Other			10.0		
INITIAL SPARES				7.7 (2%)	9.0
FEE				27.7 (6%)	32.5
TOTAL PROCUREMENT				409.7 (92%)	471.5
RDT&E (FY87-91)				36.3 (8%)	38.9
Software			22.3		
Hardware			2.4		
Other			11.6		
TOTAL RDT&E & PROCUREMENT				446.0 (100%)	510.4

[a] This estimate is currently being reassessed and will be revised downward.

BW (10-30) 4

E-31

(U) Comparison of the two estimates for MIFASS hardware (current estimate and the estimate from the 1984 life cycle cost study; see Table 3B.9a) shows that the current estimate is 14 percent lower than the estimate made 2 years ago. No detail on the engineering data to explain these changes has been provided for this assessment.

(U) Cost estimates for the production contract to be awarded in FY 89 or FY 90 are based on the EDM competition and data provided by the subcontractors for EDM. Although the prime contract will be sole source, competition is expected at the subcontract level. The Microcomputer (representing 17.6 percent of the hardware costs) is specified to be the AN/AYK-14. The Mass Memory, Mass Storage Device, Dynamic Situation Display, and cable sets are all provided by the prime contractor; these four components represent 38.3 percent of the hardware costs. It is difficult to predict the impact of competition at the subcontract level, but it may be limited to 44 to 62 percent of the hardware, depending on whether competition is possible for the Microcomputer. Since the primary basis for cost estimates of subcontracted components is the 1979 EDM competition, cost estimates for a 1989 or 1990 production contract are difficult to make with any confidence.

OPTION 3B - MARINE CORPS FIELDS MIFASS

TABLE 3B.9c COST OBSERVATIONS

- COSTS FOR MIFASS HARDWARE ARE BASED PRIMARILY ON ENGINEERING ESTIMATES MADE IN 1979 AT TIME OF EDM COMPETITION AND CONTRACT AWARD; ADJUSTMENTS MADE DURING THE LAST YEAR WERE DOWNWARD (14%) FROM 1984 LIFE CYCLE COST STUDY

- ACTUAL COSTS WILL NOT BE KNOWN UNTIL PRODUCTION CON-TRACT IS AWARDED IN FY 89 OR FY 90
    - PRIME CONTRACT IS SOLE SOURCE
    - COMPETITION AT SUBCONTRACT LEVEL IS EXPECTED BY USMC

- EXTENDED TIME BETWEEN EDM COMPETITION AND PRODUCTION CONTRACT AWARD MAKES IT DIFFICULT TO PREDICT THE DEGREE OF COMPETITION AND TO ESTIMATE COSTS WITH CONFIDENCE

E-33

BW (10-31) 3

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E-34

APPENDIX F
OTHER INFORMATION

- SECDEF REQUIREMENT FOR AN INDEPENDENT ASSESSMENT OF AFATDS AND MIFASS

- AFATDS AND MIFASS SCHEDULE COMPARISON

- EXAMPLE OF CONNECTION OF COMPONENTS

F-1

LS-19-25

(U) This chart shows two of the documents that initiated the IDA study. On 18 April 1986, SECDEF indicated that a decision had been made to conduct an independent study of fire support C3 programs. He further stated that a purpose of the study was "to ensure maximum cross-Service commonality and interoperability of these systems." On 15 July 1986, USDRE directed the Services to conduct a review and provide a joint briefing for AFATDS and MIFASS, including an in-depth examination of the three alternatives:

1. Marines terminate MIFASS and join AFATDS

2. Army terminates AFATDS and joins MIFASS

3. Continue both efforts as currently programmed.

(U) The USDRE memorandum of 15 July 1986 specified that the Services "as a minimum, address cost, schedule, and operational impacts resulting from the choice of either Alternative 1 or 2." The memorandum further stated that IDA had been asked to conduct an independent assessment of the Service positions.

SECDEF REQUIREMENT FOR AN INDEPENDENT
ASSESSMENT OF AFATDS AND MIFASS

"Thank you for your letter... concerning DoD Management of Fire Support C³ programs. We have decided to accept your suggestions to conduct an independent DoD Study..."

Caspar W. Weinberger
18 April 1986

"The issue of duplication in the AFATDS and MIFASS programs has been raised by the GAO and more recently in Congress... a review of both programs should be conducted at this time to examine in depth [three] alternatives..."

"... In accordance with the wishes of the Secretary of Defense, IDA has been asked to conduct an independent assessment of the Service positions..."

Donald A. Hicks
15 July 1986

UNCLASSIFIED

F-3

(U)   This chart provides an overview of the schedules for AFATDS and MIFASS.   The schedules include important milestones and the amount and percent of the programmed procurement funds for each program.   The data for this schedule are current as of 18 November 1986.

(U)   For AFATDS, the ACCS RFP is planned for 2Q FY 87, with an award 1Q FY 88.   During the interim, a Milestone II is planned.   Initial ACCS hardware (Version 1 NDI with extended temperature and vibration) would be delivered within 90 days of the ACCS award, and the initial rugged hardware (Version 2) would be delivered 300 days after the ACCS award.   AFATDS Milestone III follows the completion of Version 1 software testing in 4Q FY 89.   The IOC for Version 1 software for AFATDS is planned for the end of 1Q FY 90.   Version 2 software would achieve IOC sometime in FY 91.   The AFATDS procurement plans provide 30 percent or $84.7 million[1] in FY 88 to support fielding in FY 90.   An additional 19.7 percent ($55.5 million) of the procurement is planned for FY 89 to support fielding to a corps equivalent in FY 91.   The total planned procurement, as indicated on the right side of the chart, is $281.6 million.   Thus, nearly 50 percent of the procurement funds are programmed prior to Milestone III.

(U)   The bottom part of the chart is the schedule for MIFASS.   Key events are completion of OT II in 3Q FY 87 and Milestone III in 4Q FY 87.   The IOC in 1Q FY 93 is based on starting production in 1Q FY 90.   The Marine Corps is considering an alternative development strategy with start of production in FY 89 and IOC in FY 92.   The period from the completion of OT II to the beginning of production is planned for preproduction engineering and software development.   The POM procurement funding for MIFASS begins with $26.4 million in FY 90, 13.4 percent of the $196.1 million total procurement planned.   An additional $47.8 million would be required in FY 91.

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[1](U) All costs cited here are in constant FY 87 dollars.

AFATDS AND MIFASS SCHEDULE COMPARISON

F-5

BW (11-18) 1

(U)   This chart identifies the components of the two systems and shows a way in which each system might be configured. External communications interfaces are shown as two-way arrows, and interfaces for power are shown as one-way arrows. Although only one each of most components is shown in the chart, additional components are typically present; these would be configured in the same way as the components shown.

(U)   MIFASS has its external digital interface through the DCE. The digital data links of all components are through one of the Star Couplers, with the exception of the Type 1 Printer, which is a peripheral to a DSD. The voice communications interface for MIFASS is through the CCP. Power is provided to all MIFASS components through the Power Module. A number of Battery Boxes, typically 8 to 14, are used for backup power.

(U)   The digital devices for AFATDS are to be connected through a fiber optic local area network. External interfaces are provided by modems in the FSTs and FSCTs. The FST is capable of operating standalone, and the EP and PLU can be connected to the FST as peripherals (these options are not shown in the chart). A Power Converter Group is shown for AFATDS, providing power to all the other components. Some (or all) of the components may be operable with direct connection to available power (not shown). Details for the AFATDS configuration, including the need for a separate component for power, will not be developed until the results of CEP are available and the selections are made for the ACCS equipment.
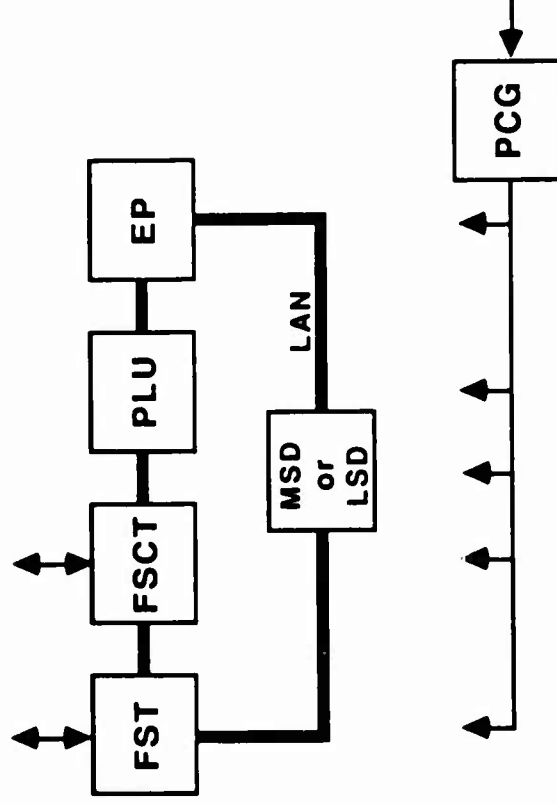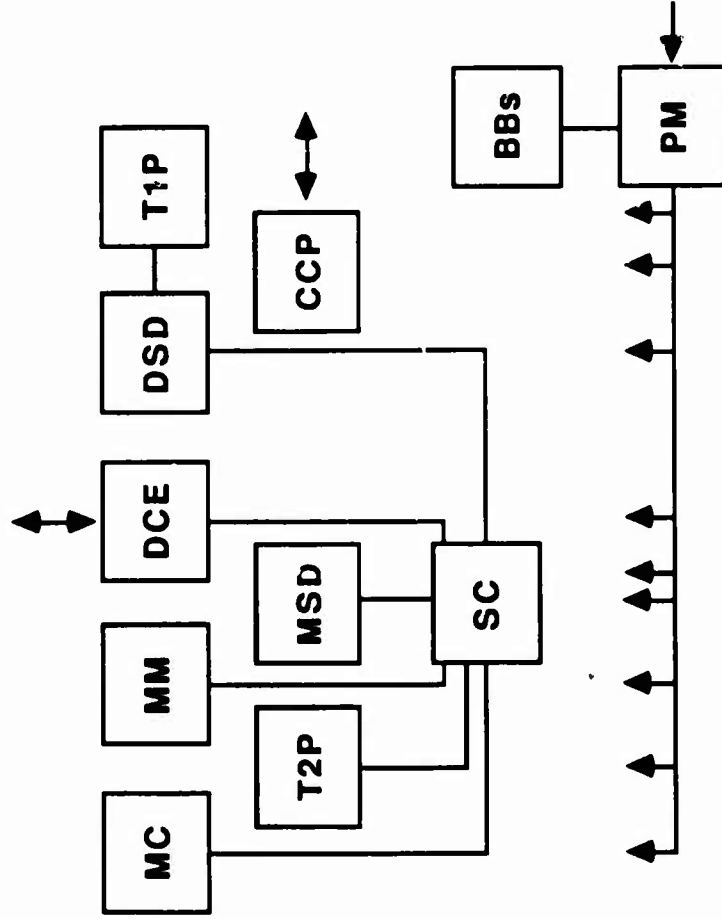
EXAMPLE OF CONNECTION OF COMPONENTS

AFATDS

FST — FSCT — PLU — EP

MSD or LSD

LAN

PCG

MIFASS

MC — MM — DCE — DSD — T1P

MSD

T2P

SC

CCP

BBs — PM

MC = Microcomputer
MM = Mass Memory
DCE = Digital Communications Equipment
DSD = Dynamic Situation Display
T1P = Type 1 (Slow) Printer
T2P = Type 2 (Fast) Printer
MSD = Mass Storage Device
CCP = Communications Control (Voice) Panel
SC = Star Coupler
BB = Battery Box

PM = Power Module
FST = Fire Support Terminal
FSCT = Fire Support Computer Terminal
PLU = Program Load Unit
EP = Electronic Printer
MSD = Medium-Screen Display
LSD = Large-Screen Display
LAN = Local Area Network
PCG = Power Converter Group

F-7

LS-19-38

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F-8

APPENDIX G

BACKGROUND, OBJECTIVE, AND ADDITIONAL GUIDANCE (U)

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Appendix G

BACKGROUND, OBJECTIVE, AND ADDITIONAL GUIDANCE (U)

(U) This report was written in response to Task Order T-J1-443. Those portions of the task order that pertain to the background and objectives of the task, and the additional guidance provided therein by the sponsoring office, are reprinted here.

BACKGROUND (U)

(U) The Army and Marine Corps are in the process of developing computer systems to support their battlefield fire control functions. The Army's Advanced Field Artillery Tactical Data System (AFATDS) is in initial development and the Marine Corps' Marine Integrated Fire and Air Support System (MIFASS) is in test. Both of these systems are planned for fielding in the early 1990s.

(U) The issue of consolidating these programs has been under consideration for several years. The GAO evaluated the programs and recommended their consolidation. DoD has concurred with the GAO findings and agreed to review the situation.

(U) OASD(C3I) and OUSDRE are in the process of tasking the Services to produce decision briefings on the consolidation of the two programs.

OBJECTIVE (U)

(U) The objective of this task is to provide an independent assessment of the Service decision briefings and supporting material, and of the consolidation tradeoffs in general.

ADDITIONAL GUIDANCE (U)

a. (U) A review of the relevant documentation including the Service inputs, and discussions with the military users and developers and their contractors.

b. (U) An assessment of the Service positions on consolidation.

c. (U) An assessment of the following options in terms of the fire control functions each Service needs to support on the battlefield and the planned timeframes for the fielding of the systems:

- Both Services field AFATDS
- Both Services field MIFASS
- The Army field AFATDS and the Marine Corps field MIFASS.

G-4

APPENDIX H

DISTRIBUTION LIST FOR IDA PAPER P-1991 (U)

H-1

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H-2

Appendix H

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H-6